Work participation and work capacity in early osteoarthritis of the hip and the knee

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RIJKSUNIVERSITEIT GRONINGEN

Work participation and work capacity in early osteoarthritis of the hip and the knee

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Voor mijn ouders, Lambert en Jannie Bieleman
en voor Lienke, Jeltje, Lena en Kars.
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CONTENTS

Chapter 1

Introduction

INTRODUCTION

Osteoarthritis (OA) of the hips and the knees can restrict people in several physical functions, of which one is undoubtedly the most prominent: walking from one place to another. In many patients this basic function may be impaired by pain and stiffness in the joints. Moving around is an essential aspect of many activities in daily life, for example during house keeping, travelling, sports, leisure activities and working. Although many people spend a lot of their time working, either self-employed, employed or voluntary, little attention has been given to the impact of OA on working life [1]. The main reason for this is that OA has long been considered to be a disorder of the elderly and not of people in the working age, which is generally defined as 18-65 years. Only recently it was pointed out that significant proportions of people with OA are still working and that their work capacity may be limited because of their joint complaints [2]. Still, pain in hips and knees and disability during or after hard physical work seem to be considered normal or inevitable, and jobs-at-risk have been identified, like farming, carpet-laying and cleaning [3-6]. Where for example low back pain or complaints of neck, arm and shoulders (CANS) are considered as widespread occupational diseases, OA of the hips and knees is not. This may explain the lack of attention in research for the relation between OA and work: neither clinicians, nor occupational professionals have really signaled the issue.

To describe and analyze the impact of OA on an individual's health, the International Classification of Functioning, Disability and Health (ICF) can be a helpful tool. The ICF was developed by the World Health Organization (WHO) as a framework for measuring health and disability [7]. Relations with participation in paid work and with work related activities fit into this model, as well as the influence of environmental and personal factors [Figure 1].

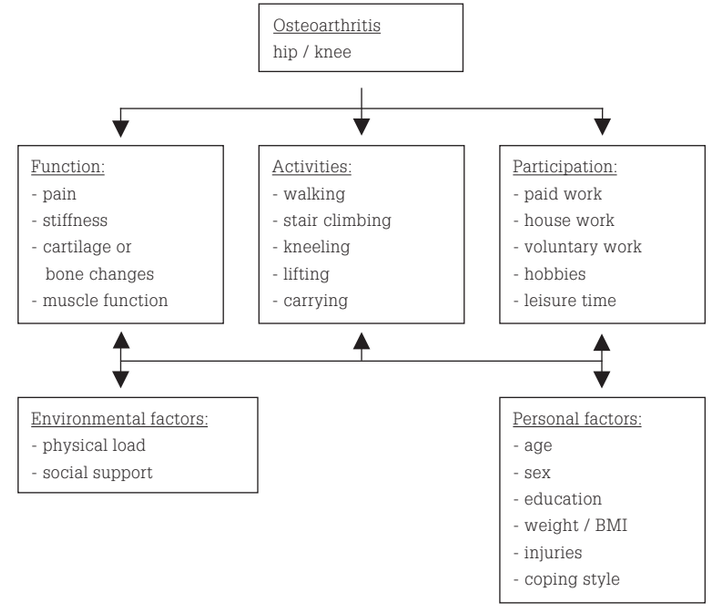

Figure 1:
The ICF model applied to osteoarthritis of hip and / or knee

For example, the biomechanical effects of work load for an individual with OA can be analyzed, regarding their effect on cartilage and on the capacity to perform physical activities, but moreover the model offers a wide perspective on health. A strong, new aspect is that it specifically points out the possible positive influence of social participation on health. In the same line of reasoning, a wide approach to the health situation of OA patients is recommended [8-10]. A lot of evidence is also available in a recent review regarding the beneficial effects of work, as a major component of social participation, on health [11].

The effect of early osteoarthritis on work participation and work capacity is the subject of this thesis. This introductory chapter starts with the epidemiology of OA of hip and knee and a brief overview of the therapeutic options. Next, the current view on the relation between OA and work will be outlined. Thereafter, the Cohort Hip and Cohort Knee (CHECK) study on which this PhD study was performed, will be described. The chapter ends with the objectives of this thesis, the research questions and the outline.

Prevalence and incidence of osteoarthritis (OA) of hip and knee

January 2007, 240.000 males (95%-CI: 157.000 - 362.000) and 417.000 females (95%-CI: 283.000 - 597.000) in the Netherlands were estimated to have osteoarthritis in one or more joints [12]. So in the Dutch population 30 per 1.000 males and 50.4 per 1.000 females have OA. The most frequent location of OA is the knee [Table 1]. The prevalence of OA increases with age.

Table 1:
Prevalence and incidence of OA in the Netherlands

	Prevalence (per 1.000)		Incidence (per 1.000 per year)	
	Males	Females	Males	Females
OA of the hip	10.2	18.9	1.2	2.1
OA of the knee	14.3	23.8	1.6	3.1

The sources of these figures are registrations by general practitioners; the numbers of OA in the population are estimated to be 2.0 to 3.5 times higher than those registered. The degree of disabilities and complaints that patients have depends on several factors, such as age, location of the impaired joint, radiological degree of OA, presence of co morbidity, pain, psychosocial factors, depression, muscle weakness, poor general condition, overweight, lack of physical activity, low self-efficacy, low socio-economic status and combinations of these [13]. Pain and deterioration of functional status as a result of OA in hip or knee seem to progress slowly in time [14].

An increase in the prevalence of OA is expected, because of ageing of the population and an increasing proportion of overweight and obese individuals, a consequence of the modern unhealthy Western lifestyle. Still, in regular health care and modern society there is relatively little attention for OA, maybe because it is neither lethal nor has a spectacular clinical course. OA seemed to be considered an inevitable, commonplace consequence of ageing, with few treatment options [15-17] However, this view is changing and OA is recently considered to be a surprisingly complex disease in which the whole joint is involved and not only the cartilage [18]. Systemic factors play a role, but local biomechanical factors also have influence. The correlation between the disease process and musculoskeletal pain and disability is weak; co morbidity and personal factors are strong determinants of disability.

At present there is no cure for OA. Control of pain and improvement in function and health-related quality of life are the goals of OA management [15-19]. Pharmaceutical therapy may consist of non opioid analgesics, non steroid anti-inflammatory drugs (NSAID) or opioid analgesics. Avoiding therapeutic toxicity is an important aspect of treatment. Exercise, bracing, behavioral interventions and surgical treatment are the other available options. Interventions specifically aimed at resuming work have also been developed [20-23].

Osteoarthritis and work

Recently the attention for this issue increased, both in journals on occupational health [24;25], epidemiology [26;27] and rheumatology [28;29]. Physical work load has since long time been recognized as an important risk factor for the development of OA; this can be depicted by the arrow from 'Environmental factors' to 'Function' in Figure 1. The inverse relation, that is the impact of OA on work capacity and work participation (arrow from 'Function' and 'Activities' to 'Participation' in Figure 1) has been addressed frequently in studies on the economic impact of the disease, but calculations have not been developed ay further than the stage of estimations and projections [30;31]. The real interest in the social impact of OA for the patient, including the effect on work ability, is from a more recent period [8;9;30;32], probably urged by demographical reasons. With the ageing of populations the prevalence of OA will increase and this development will have a major impact on the socio-economical situation in several countries. To afford the costs of health care and social security systems, many governments want to increase the work participation rate of people older than 55 and of women in general. In the Netherlands in the last decades many older workers have been facilitated to retire much earlier than the pensionable age of 65. As a consequence the work participation rate in the populations older than 55 is relatively low.

In the current situation two opposite trends cross each other: in the ages between 55 and 65 year the work participation in the open population decreases drastically, whereas the prevalence of OA (and other chronic health problems) increases. These opposite trends constitute the background for this thesis. Shifting the pensionable age and the end of the working life period may change the interactions between health, work capacity and work load of workers [33;34].

On the one hand, work that is adapted to the (in)abilities of older workers and workers with health problems may support their health and functioning, whereas on the other hand unfavourable work conditions may cause overload and drop out.

The interactions between OA, work, age, self-reported health and functional capacity are the topic of this thesis: work participation and work capacity of people with the early stage of osteoarthritis of the hips and / or the knees.

Cohort Hip and Cohort Knee (CHECK)

In the opinion of the Dutch Arthritis Association ("Reumafonds") until now osteoarthritis has not been given the attention by research that is needed. Given the impact of the disease on patients and on society and the expected increase in OA prevalence, more insight into its' nature, course and prognosis is needed. For this reason the association funded the Cohort Hip and Cohort Knee (CHECK study) [35], a 10-year prospective multicenter study in a Dutch cohort of 1002 people with suspected early OA of the hip and/or the knee. Considering the inclusion criterion for age (45-65 at baseline) CHECK is an interesting cohort for studying the (early) effects on work participation.

Main objectives of CHECK were to describe the course of the disease and to identify determining factors of this course, with regards to functions, activities and participation. The 10-year period coincides with the Bone and Joint Decade of the World Health Organization (WHO). This thesis is based on the analyses of data of the baseline and 2-years follow-up measurements regarding participation in paid work of all people in the cohort and on a spin-off study on functional capacity of 93 cohort participants from the regions of Groningen and Twente.

Main objectives of this thesis

1. To review the literature on the impact of OA on work participation, as a major aspect of social participation of patients. [Chapter 2]
2. To determine the participation rate in paid work of Dutch subjects with early OA of hip and knee and to compare this to work participation in the general Dutch population and in Americans with early OA. [Chapter 3]
3. To determine frequencies of sick leave and work adaptations in subjects with early OA because of complaints of their hip and knee or because of other health problems. [Chapter 3]
4. To document the 2-years course of work participation and to identify differences in characteristics between subjects who continued working and subjects who stopped working. [Chapter 4]
5. To investigate stability of three FCE test items (lifting low, lifting overhead, carrying) in subjects with early OA of hip or knee on two consecutive days, to analyze consistency of individual test results, and to analyze whether pain, hip and/or knee complaints and disease severity are possible sources of individual variation. [Chapter 5]
6. To describe the relation between on the one hand the self-reported scores on SF-36 'physical function' and WOMAC 'function' and on the other hand performance on a Functional Capacity Evaluation (FCE) and to study the diagnostic properties and diagnostic values of SF-36 and WOMAC in predicting limited functional capacity on the FCE. [Chapter 6]
7. To compare the self-reported health status and the observed functional capacity on an FCE of subjects with early OA of hip or knee to healthy workers. [Chapter 7]
8. To determine if the functional capacity of subjects with early OA is sufficient to meet physical job demands. [Chapter 7]
9. To determine relations between self-reported physical functioning (WOMAC) and functional capacity, participation in paid work and physical activity during leisure time in women with early OA of hip or knee. [Chapter 8]

Outline of the thesis

In Chapter 2 a systematic review of existing literature on the effect of osteoarthritis on work participation is described.

Chapters 3 and 4 are based on data from all cohort participants (n=1002) and describe base-line and 2-years follow up analyses of work participation.

In Chapter 3 the CHECK subjects are compared, matched for age, sex and education level, to the general Dutch population and to the American Osteoarthritis Initiative (OAI) cohort study. In both cohorts the self-reported health and functional status of subjects with a paid job are compared to those of subjects without paid jobs. Furthermore, the prevalence of sick-leave and work adaptations is determined. In Chapter 4 the course of work participation from baseline to 2-years follow-up measurement is described. Health and functional status and personal factors of subjects who stopped working are compared to those who continued working. Prevalence of sick-leave and work adaptations is measured and compared to baseline.

The findings in Chapters 5 to 8 are based on the spin-off study on 93 subjects who participated in Functional Capacity Evaluation (FCE).

Chapter 5 examines the reproducibility of FCE in subjects with OA and answers the question whether 2-day testing is necessary. By comparing the self-reported functional status (in SF-36 and WOMAC questionnaires) to the observed performance in an FCE test, a diagnostic model is constructed [Chapter 6]. In Chapter 7 the functional capacity and self-reported health of people with early OA are compared to healthy workers, in order to assess the effect of their hip or knee complaints on these parameters. In Chapter 8 the association of self-reported function of female subjects from the cohort with their work status and their physical activities in daily life is examined.

In the last chapter the main findings of the thesis are presented and the results and some methodological issues are discussed. Furthermore, implications and recommendations for health care, society and future research will be given.

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Chapter 2

The impact of osteoarthritis of hip or knee on work participation. A Systematic Review

Submitted

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ABSTRACT

Introduction

The aim of this study was to systematically review the literature on the impact of osteoarthritis (OA) on work participation.

Methods

A systematic literature search was performed. Studies involving patients with hip or knee OA and outcome measures on work participation were included. Methodological quality was assessed using a standardized set of 11 criteria; a qualitative data analysis was performed.

Results

Screening of 1861 titles and abstracts resulted in a selection of 53 full-text articles. Data were extracted from 14 articles that were included in the final selection. Design, populations, definitions and measurements in the studies showed large variations. In many studies work outcomes were only secondary objectives and analyses may have been prone to confounding. With some reservation the outcomes can be summarized as showing a mild negative effect of OA on work participation. Many patients had paid work and managed to stay at work despite limitations. Levels of sick leave and early retirement were not very high or not different from controls.

Conclusion

This review indicates a mild negative effect of OA on work participation. However, research on the impact of OA on work participation is scarce and the methodological quality is often insufficient. The longitudinal course of work participation in individuals with OA has not been described completely.

INTRODUCTION

Osteoarthritis (OA) is a disorder with a high prevalence and a substantial burden of disease [1-3]. Patients experience pain and stiffness in the affected joints and functional limitations in daily life [4]. Although the prevalence of OA is highest amongst elder people in the population, the early stage of OA starts at an age where people are still working [5-8]. There is a bidirectional relation between OA and work. On the one hand several aspects of physical work load have been identified as risk factors for developing knee and hip OA, as for example kneeling work positions, jumping and heavy lifting [9-15]. On the other hand, people who have OA may perceive difficulties in performing work. This latter effect can subsequently lead to decreased productivity, sick leave, (long-term) work disability and early retirement [16;17]. Measures to reduce these effects may address the work situation [18], as for example by adapting hours, tasks, work place/work load and the use of aids, as well as the person, for example by applying physical training and coping programs [19;20]. However, studies on work disability prevention in rheumatic diseases and on the impact of OA on work, as well as intervention studies, are still scarce [21;22].

From a societal point of view the costs of these phenomena are of major importance. For the individual with OA, aspects such as sick leave, adaptations in the work situation or even inability to continue work due to OA are equally important for the personal well being. Considering the anticipated increase in OA prevalence (due to ageing populations and more obese people) and the political aim to increase work participation in elderly [23-25], this issue needs more attention in research. In addition, it is important for occupational health professionals as well as for treating physicians and therapists to gain insight in the need for adaptations in the work situation due to OA. For these reasons the aim of this study was to review the literature on the impact of OA on work participation as a major aspect of social participation of patients.

The study questions of this literature review were:

1. What is the impact of OA of hips and knees on work participation in terms of work productivity, sick leave, work disability and early retirement?
2. What is the frequency and nature of work adaptations that people have made because of OA?
3. Does the impact of OA of hips and knees on work change with disease progress?

METHODS

Literature search

In June 2009 Medline, Embase, Cinahl and PsycInfo were searched with the following terms and combination of terms: {((knee OR hip) AND (artrosis OR arthrosis OR osteoarthritis)) OR coxarthrosis OR gonarthrosis} AND {'work participation' OR 'paid work' OR occupation* OR employment OR 'sick leave' OR burden OR impact OR 'work transitions' OR 'work adaptations' OR 'work changes'}.

First, titles and abstracts obtained by the search were screened on relevance for our study questions by two of the authors independently (HJB and SMAB-Z). Secondly, after this pre-selection, full-text articles of relevant titles and abstracts were also screened by two of the authors independently (HJB and SMAB-Z) for final inclusion. Reference lists of these articles were analyzed for additional titles. In case of disagreement on the selection, a consensus meeting was held between the 2 authors. If disagreement was still present, a third author (APV) acted as referee.

Selection criteria

Studies were finally included if they met the following criteria. A study population of people with OA in the working age (18-65 years) was presented, or a part of the study population were people with OA in the working age and there were separate reports on these people or having OA was analyzed as a determinant. Data on work participation were presented and a quantification of the impact of OA on the participation was presented (decrease in productive hours, sick leave, work disability, work adaptations, early retirement). Studies were published in English, German, French or Dutch and were available as full-text article. Articles that only presented estimates in terms of lost money, without data on the factors upon which these costs were based, were excluded.

Assessment of risk of bias

Two authors (HJB and SMAB-Z) independently assessed the methodological quality of the articles that were included in the final selection. A specific set of assessment criteria were formulated, based on existing criteria lists (Appendix), considering the aim of

this review, that is to describe the impact of OA on work. The internal validity was the main aspect to be judged, in order to assess the risk of bias and to inform the reader about the quality of the studies with respect to our research questions. The internal validity of studies assessing the impact of OA on work may be threatened in different ways: by selection bias, in case of disproportionate inclusion of either relatively healthy patients or patients with severe complaints; by confounding, if other patient characteristics (age, education level) have a strong effect on work participation; or by information bias, in case of unreliable or invalid measurement. The criteria were therefore grouped into four categories: the study population (selection bias), the validity of assessing determinants (OA and possibly confounding determinants of work outcomes), the validity of reported work measures (information bias) and the quality of data analysis (to correct for all factors). The possible judgments were 'yes' (coded +), 'no' and 'unclear' (both coded –; Table 1). Cohen's Kappa's were calculated to assess agreement between the reviewers (before consensus was reached).

RESULTS

Study selection

The searches in Medline, EMBASE, Cinahl and PsycInfo resulted in 1476, 261, 108 and 16 titles, respectively. Screening of these 1861 titles and abstracts resulted in a selection of 53 full-text articles that were studied thoroughly. From the reference lists one additional title was added. Finally fourteen articles were included in the review, from which the data were extracted and analyzed.

Quality assessment: risk of bias

Results of the quality assessment are presented in Table 1.

Authors	A. Study population	B. Source population	C. In- / exclusion criteria	D. Valid OA diagnosis	E. Relevant prognostic factors	F. Standardized / valid progn. measurements	G. Presentation prognostic factors	H. Relevant outcome measures	I. Standardized / valid outcome measurements	J. Presentation outcome measures	K. Multivariate estimates	Cohen's Kappa per study
Gignac 2008 (26)	+	+	+	-	+	+	+	+	+	+	+	NA (9/11)
Grotle 2008 (27)	+	+	+	-	+	+	+	+	+	+	+	0.16
Merx 2007 (28)	+	+	-	+	-	-	-	+	+	+	-	0.29
Rabenda 2006 (29)	-	+	-	-	+	+	+	+	+	-	-	1.0
Fautrel 2005 (30)	+	+	+	+	+	+	+	+	+	+	-	0.74
Gupta 2005 (31)	+	+	-	+	+	+	+	+	-	+	-	0.31
Leardini 2004 (32)	-	+	+	+	+	+	+	+	- *	- *	-	0.35
Maetzel 2004 (33)	-	+	+	+	+	+	+	+	+	+	-	0.62
Woo 2003 (34)	-	+	-	+	+	-	+	+	+	+	-	1.0
Lerner 2002 (35)	-	+	+	+	+	+	+	+	+	+	+	0.30
Gabriel 1997 (36)	-	+	-	+	-	-	-	+	+	+	-	0.79
Mäkelä 1993 (37)	+	+	+	+	+	+	+	+	+	+	+	NA (8/11)
Pincus 1989 (38)	+	+	+	-	+	+	+	+	+	+	-	NA (8/11)
Julkunen 1981 (39)	-	+	+	+	+	+	+	+	+	+	-	0.56

* : outcome measures presented, but unclear and difficult to control
NA : not applicant, Kappa could not be calculated because one of the authors rated only positive scores;
( ) indicate number of items out of 11 on which agreement consisted

Table 1:
Methodological quality of included studies (after consensus was reached)

Authors + country	Study design and study aim	Subjects: n, %female (F), age, disease stage	Diagnosis of OA	Methods of work data collection
Gignac et al. 2008 (26) Canada	Prospective 4.5 year cohort study; 4 time points, each 18 months apart Aim: to prospectively examine arthritis-related work transitions and factors associated with it	At baseline n=490 (278 OA, 49 OA+RA, 163 RA), 78% F, all workers. Mean age 50.9, mean disease duration 9.2 year (SD 8.7)	Criteria: a reported physician diagnosis of inflammatory arthritis or OA, duration > 1year	Method: 2 hour interview based on structured questionnaire; Workplace Activity Limitations Scale (WALS). Work transitions: productivity loss, work changes, leaving employment + demographic, illness, work context and psychological variables
Grotle et al. 2008 (27) Norway	Cross-sectional population survey, postal questionnaire. Aim: to investigate prevalence of OA in knee, hip and hand	A community population, n=3266 (55% F, median age 45), overall OA prevalence = 12.8% (n=418)	Self-reported physician diagnosed OA	Postal questionnaire: socio-demographic and lifestyle variables (incl. work status); muscskel. symptoms: Stand. Nordic Pain Q.; emotional distress: Gen. Health Q.; QoL: COOP-WONCA, medical consumption. Logistic regression
Merx et al. 2007 (28) Germany	Cross-sectional analysis of several databases (health care institutions, government authorities, public health insurance). Aim: to summarize the impact of medical care and related costs due to treatment of OA in Germany	Data of 600.000 patients were analyzed	(Partly) based on ICD-classification (ICD-9:715 and ICD10-M15-19)	Amount and costs of acute and rehab treatments, sick leave and early retirement related to OA were estimated
Rabenda et al. 2006 (29) Belgium	Prospective cohort (6 months). Aim: To estimate direct and indirect costs of OA	N=1811, employees of City Council, 57% F, mean age 45.9 (SD 9.8). OA-prevalence=34%	Self-reported diagnosis	Subjects completed a health record: demographics, socio-economics, health care utilization, sick-leave, reduction of activities, HRQOL
Fautrel et al. 2005 (30) France	Cross-sectional national survey, recruiting OA patients via 5000 French physicians. Aim: to assess the clinical burden of OA	N=10412 OA patients, mean age 66.2 (SD 10.2), 66% F; mean disease duration 9.3 year (6.8)	Doctor diagnosis (and radiographic for 84.5% of patients)	Questionnaire: part 1 – physician: medical information; part 2 – patient: impact on activities of daily life, including occupation ("are you limited in your ability to …")
Gupta et al. 2005 (31) Canada	Cross-section population OA cohort. Aim: to estimate direct and indirect attributable costs	N=1258, 74% F, mean age 73.1 (59-100); 96.3% were retired; 37 still worked	96% had clinical signs of hip and/or knee OA	Telephone interview, using standardized questionnaire
Leardini et al. 2004 (32) Italy	Retrospective 12 months cohort. Aim: to estimate the burden of knee OA	n=254, GP-diagnosed, mean age 65.8, 76% F; 21% work (=54), 42% housewife, 35% pension; OA duration 8.6y	Diagnosis: ACR-criteria + K&L-score	Identifying, measuring and appraising resources absorbed by the patients. Indirect: production loss, working days lost, reduction/loss of work activity and informal care
Maetzel et al. 2004 (33) Canada	3 Cohorts, included by rheumatologists and family physicians (OA, RA, HBP) analyzed at baseline and 3 months. Aim: to compare economic burden	253 RA (57+13y, 80% F) 140 OA (70+8y, 70% F) 191 OA+HBP (72+8y, 75% F) 142 HBP (68+9y, 61% f)	Physician diagnosed OA of knee (185), hip (99), hand (99), spine (176)	Telephone interview/questionnaire (at 0 + 3 months) on demographics, health status, co morbidity, use of health care, time lost from work
Woo et al. 2003 (34) HongKong	Retrospective cross-sectional study, cohort with 3 OA subgroups (mild, severe, prosthesis). Aim: to determine direct and indirect costs of OA	n=574, 76% F, 47% older than 70 year	ACR classification for functional status, based on self-report	Indirect cost estimates included days of sick leave, days off work by relatives/friends in helping the patient, loss of job because of OA. Human capital approach to assess productivity loss
Lerner et al. 2002 (35) USA	Cross-sectional survey. Aim: to assess aspects of reliability and validity of the Work Limitations Quest. (WLQ)	230 employed OA patients (mean 53.7, 65% F) + 37 healthy employed controls (mean 45y, 54% F)	Physician diagnosis + mostly also radiological	Work Limitations Questionnaire (25 items), SF-12, WOMAC, chronic condition checklist, occupation battery, PGA, demographics
Gabriel et al. 1997 (36) USA	Cross-sectional comparison of cohorts (OA, RA, controls). Aim: to describe economic effects of these disorders	123 RA (61;29-92y; 68%F) 116 OA (68;32-102y; 69%F) 94 controls (42;20-100y; 51%F)	Physician diagnosed OA. Location of OA unclear ('peripheral joints')	Pretested postal survey. HAQ. Number of work days missed, miles travelled for care

Table 2:
Articles presenting original data on work participation, work disability, sick leave and work adaptations: study characteristics

Mäkelä et al. 1993 (37) Finland	Cross-sectional study in the Mini-Finland Health Survey	n=5673 aged 30-64. Prevalence of knee OA 4% (229) and hip OA 1.8% (101)	Physician diagnosis	Interview + questionnaire + screening examination. Multivariate analyses on determinants of disability, incl. reduced work capacity
Pincus et al. 1989 (38) USA	US SocSec Survey of Disability and Work; interviews. Aim: to analyze earnings losses in (surrogate) RA and OA (cross-sectional).	n=9859, 18-64y, answering Yes to "doctor told …. arthritis or rheumatism"	Self-reported OA of knee, hip or hand	Disability, work status, earnings losses
Julkunen et al. 1981 (39) Finland	Aim: to clarify etiological, social and therapeutic aspects of OA and STR; cross-sectional case-control study.	690 OA patients (58y, 67% F) from Health Centers + 690 random controls. Also 475 soft tissue rheumatism and controls	Physician diagnosed OA mostly of ankle (10%), knee (50%) and hip (19%)	Standardized printed questionnaires concerning demographics, occupation, living and working conditions, health situation

Table 2: Follow-up

Two reviewers independently scored 154 items and agreed on 120 (78%; Cohen's kappa = 0.53). Disagreement was mostly caused by differences in interpretation of the criteria list or unclear reporting in the article and considered mainly the items of standardized and valid measurements of outcome measures, presentation of outcome measures and multivariate estimates. Agreement was reached by consensus after a discussion in which the referee participated.

Study characteristics

The selected articles could be categorized as follows: four studies concerned large populations surveys or data base surveys [27;28;37;38], three cohort studies concerned workers, all with OA or including OA patients [26;29;35], and seven cohort studies concerned OA patients [30-34;36;39]. The characteristics of the included studies are presented in Table 2.

Two studies were prospective: one was an OA cohort with 4.5 years follow-up [26] and one was a cohort of workers, amongst them a group with self-reported OA, with a 3 months follow-up [29]. One study had included a very large population of 10.412 patients diagnosed by a physician, of which 1750 had paid work [30]. Several studies reported on older populations with only a small minority of subjects who were still working [31-33;36]. Seven studies were performed in Europe [27-30;32;37;39], 6 in North America [26;31;33;35;36;38], and 1 in Asia [34]. Eight studies were published in the last 5 years, two 5-10 years ago and the other 4 more than 10 years ago.

Outcome measures

The results of the included studies are presented in Table 3.

Work participation

The only prospective study with a substantial follow-up period (4.5 years), demonstrated that 37% of 490 working arthritis patients (57% OA, 10% both OA and RA, 33% RA), left the labor force in this period [26]. Leaving the labor force was related to higher age, lower education, having less control over one's work schedule, working as a health or education professional, and reporting previous job disruptions and reductions to work hours. A weakness of this study was that it used patient reports of a physician diagnose and that the body sites of arthritis were not specified.

OA was independently related to having work limitations, being on sick leave and being out of work, in two large population surveys [27;37]. Work participation rates, matched for age and sex, were equal for OA patients and healthy controls in two cross-sectional studies [30;39]. Another one [38] showed that the work participation in subjects with OA (age 18-64) was lower than in controls without arthritis, in both men and women, but additional analysis demonstrated that age, education level and co morbidity explained a large part of this difference. The impact on work of OA was smaller than that of Rheumatoid Arthritis in 3 comparative studies [33;36;38]. The other 6 cross-sectional studies did not report work participation rates or no comparisons with controls were made.

Authors	Work status	Disability, sick leave/reduced production	Work adaptations	Early retirement
Gignac et al. 2008 (26)	63% remained employed; 70% made at least 1 work change; diagnosis is not predictive for work transitions score	40% have been absent, mean duration 4.5 days	75% reported work transitions	37% Stopped working during the 4.5 year follow-up period
Grotle et al. 2008 (27)	12.8% reported OA; median age was 45, 55% were women; 70.6% were employed	Having OA was related to being on sick leave more than 8 weeks (hip OR=4.19, knee OR=1.95)	-	OA was related to being out of work (hip OR=3.34, knee OR=2.47)
Merx et al. 2007 (28)	No information on course of OA + on proportion who are not work disabled	Estimated 240000 yearly cases of OA-related work disability (1.6-2.3% of sick leave days); mean duration 37 (knee OA) and 56 (hip OA) days	-	OA caused 4.9% of cases of early retirement (all data are from 2002)
Rabenda et al. 2006 (29)	616 workers with OA	On average 0.8 days per month sick leave per patient	-	-
Fautrel et al. 2005 (30)	17.5% (+1750) had paid work, equal as in age- and sex matched controls	60.5% (hip) and 65.7% (knee) of these reported occupational limitations (compared to 14% of the controls); 6% had missed workdays because of OA	-	-
Gupta et al. 2005 (31)	96.3% were retired; 48 workers	-	-	2.5% indicated not to work because of OA
Leardini et al. 2004 (32)	54 (21.3%) were working	22% of subjects lost working days (mean: 25 days)	2% changed job during observation	2.4% reported having ceased work due to OA
Maetzel et al. 2004 (33)	Proportions of subjects employed full time: RA: 31% (78) OA: 9% (12) OA+HBP: 8% (15) HBP: 13% (18)	Subjects reporting time lost from work (in 6 months): RA: 17% - mean 137 hours OA: 4%(5) - mean 77 hours OA+HBP: 0.5%(1) - 160 hours HBP: 4.2% - 272 hours	-	-
Woo et al. 2003 (34)	Of the 574 subjects 108 have paid work. Subjects with no formal education and in the not working category had more severe disease	Fifty-seven (9.9%) patients needed to take leave from their work to see the doctor; 57 reported sick leave (12.3 +19 days)	Overall, 8 (1.4%) patients had changed jobs because of OA	Twenty-seven (4.7%) patients quit their jobs due to OA
Lerner et al. 2002 (35)	230 OA patients, all working >20 hours per week	Job effectiveness: 87% (vs. 92% in controls); 0.33 days per 2 weeks missed (vs. 0.03 in controls)	-	-
Gabriel et al. 1997 (36)	-	-	Changed occupation because OA: 1.7%; Reduced work hours / stopped OA: 10.5%; Lost job due to OA: 0.9%; Unable to get job due to OA: 9.4%	Retired early because OA: 13.7%
Mäkelä et al. 1993 (37)	-	Knee OA 229 (4%) – of which 71% had reduced work capacity, Hip OA 101 (1.8%) – of which 83% reduced work capacity	OA, especially of the hip, was a strong determinant (OR= 5.1-8.0) of occasional need for assistance	-
Pincus et al. 1989 (38)	Arthritis prev. = 11.3%. 35.5% of F with OA worked (total pop: 58%), 66.7% of M with OA (total pop: 87%). Mean age of OA subjects was 52 year vs. 37 year in subjects with no arthritis	Self-reported work disability in subjects with OA is 67% in women and 71% in men	-	-
Julkunen et al. 1981 (39)	51% of OA-patients were employed (similar as controls	Mean sick leave was 17.8 days (controls: 15.4)	31% were recommended to resume work, 4% to change occupation	21% were recommended to retire on pension

Table 3:
Articles presenting original data on work participation, work disability, sick leave and work adaptations: outcomes

The overall conclusion regarding the effect of OA on work participation is that it varied. Some studies found similar rates as in controls, one found a drop out of work of more than one third of the patients in 4.5 years. Many of the results were confounded by age, co morbidity and education level. On average there seems to be a mild decrease of work participation.

Productivity, work disability, sick leave, early retirement

The occurrence of occupational limitations, leading to reduced productivity during work, was reported in three studies [30;35;37] and found to be 3-5 times higher than in controls. Reports on lost working days because of sick leave showed varied results, but seemed to be similar to controls [39] or slightly higher [26;29;34]. One study [28] showed that OA caused a substantial part of all temporary work disability periods and early retirement in Germany. Regarding early retirement two studies [31;32] reported exactly the same proportion (2.5%) of patients who indicated not to work because of OA.

In conclusion, the pattern arising from these studies is that many workers with OA do not reach their optimal productivity during work. On the other hand is OA only in a small proportion of workers responsible for long periods of sick leave or early retirement.

Work adaptations

Three quarters of the working OA subjects in a 4.5 years follow-up study reported any kind of change to their work situation [26]. This was the only study specifically designed to monitor changes in work. In most cross-sectional studies this factor was either not reported at all, or small proportions of patients (1-10%) reported changes in their work [32;34;36;39].

Work participation and disease progress

Both the mean age and the mean disease duration of subjects in the studies varied, from a disease duration less than 1 year [39] to about 9 years [26;30;32]. From the cross-sectional studies no information on the effect of disease progression can be drawn, but they do demonstrate that many subjects with longer existing OA are (still) working. The only longitudinal study showed that in 4.5 years 63% of the subjects (mean age 50.9 year, mean disease duration at baseline 9.2 year) remained employed. In conclusion, the longitudinal course of work participation in OA has not yet been described completely.

DISCUSSION

Main findings

The main findings of this review indicate that many individuals with OA had paid work and that OA could not be proven to be a strong reason for leaving the work force due to sick listing or early retirement. Occupational limitations and reduced work capacity or job effectiveness were reported more frequently by OA patients than by controls. Sick-leave mostly did not differ from healthy populations. Work adaptations were measured only occasionally; however, they were revealed as important parameters that may precede changes like leaving the work force [26]. Due to its' high prevalence, OA was a significant factor in long-term disability statistics [28]. A as result of the differences between the studies, the magnitude could not be expressed quantitatively. Overall, it appeared that many OA patients were faced with problems in their work, but only a relatively small proportion left the work force because of these problems. However, the course of OA in relation to work participation has not yet been described completely; neither regarding changes in time, nor influencing factors.

Search strategy

Despite a broad search strategy that resulted in 1861 titles, only 14 studies were included. Many of the included studies only reported on work impact as a secondary or even lower prioritized outcome measure. The majority were designed for an overall assessment of the burden and the costs of OA for patients in a wide, but mainly higher, age range. Consequently, current effects on work were only relevant for subjects in the working age, which were often a small minority, while retrospective questions on work in the past may have suffered from recall bias. This resulted in a limited amount of relevant information or data that could not distinguish between workers and non / workers. We confirmed the conclusion that studies on the effect of OA on work are still scarce [22].

Quality assessment

In the quality assessment at first a systematic difference was noticed between the two reviewers, concerning the matter of either or not applying the criteria specifically to the questions of this review. These were different from the primary questions that

were frequently formulated in included studies. This dilemma was reflected in the kappa scores for agreement between the reviewers. An example is that OA was associated with older age and co morbidity and that patients frequently were low educated [27,38]. These factors are well-known determinants of a lower work participation rate. Therefore the results of studies that included mainly older individuals were probably confounded and the effects on work were not independently determined by OA. Discussions in which the referee (APV) participated clarified this matter and thereafter consensus was easily reached.

The diagnostic methods to determine OA varied from self-report or patient report of a physician's diagnosis, to physician diagnosis and / or radiological assessment. Besides that, all studies included patients with complaints of knee and/or hip, but sometimes also of other body regions. OA in the hands and the back may obviously have an added or different impact on work participation than knee or hip OA only. Four studies [26,27,29,38] used self-reported diagnosis only, which harmed the validity. The differences in diagnostic methods have probably led to the inclusion of different patient categories, which also hampered valid comparisons. On the other hand the association between OA related impairments (radiological status, pain, stiffness) and limitations in activities is moderate [40], while participation in work is a result of even more factors and interactions between these factors. From this perspective, in future studies on this issue the constructs of body structures and functions, activities and participation should be validly measured [41] to enable appropriate analyzes of the relations between them.

Several outcome measures were reported, as for example work status, sick leave, work disability, reduced productivity, lost work days, and work transitions. Definitions or standardisation of these variables were not always presented and different methods were used for measurement. Therefore, information bias probably occurred, which made comparison of the results of these studies questionable. Differences in conceptualization and measurement of outcome measurements have been addressed as a problem before [42]. Standardised instruments for work related outcomes need to be studied better and applied in research more often [43-45].

Implications

The findings of this review have implications for interventions. Occupational and ergonomic interventions may be applied more often to help people to stay in their job and to prevent progression of work related complaints and limitations [46]. Patients who can not meet the demands of their present job should be supported in attempts to re-integrate in another job that matches their physical capacity [7,26,47,48]. Our review demonstrated that limited research has been performed on the time course of work participation in OA. The critical periods that precede people's decision to leave the work force because of their OA have hardly been analyzed. Extrapolations and projections based on the current literature may have overestimated the impact of OA on work, because studies appear to have included mainly patients with relatively severe complaints or long disease duration, whereas patients who are functioning well in their work were outside the scope of research.

Limitations of the review

The question of the effect on work of disease progress and duration could not be answered adequately, since the continuum from early complaints, via more progressed stages until joint replacement was not covered in the literature that was selected for this review. A number of studies on the effect of surgical interventions (Total Hip Arthroplasty, THA; Total Knee Arthroplasty, TKA) on work participation have been published [49-52], but they did not meet the inclusion criteria of our study. Considering the increase in THA and TKA, their application at younger ages and the progress in surgical techniques, evaluating their effect on work participation and return to work is a relevant issue.

We realize that most of the included studies were not primarily designed to answer our research questions regarding work outcomes. As a consequence, bias and confounding with regards to this outcome measure may have been introduced in some studies and precaution should have been taken in extrapolations to conclusions on the impact of OA on work. We believe this is the first systematic review that revealed these methodological shortcomings and its' value is that we gathered basic insight into the issue of OA and work.

Recommendations

Studies on the effect of OA on work participation should preferably include both working and non working individuals with OA and compare these to both working and non working controls, over a longer period of time. Different stages of disease progress should be studied and body sites of OA specified, as well as specific aspects of work participation. Multivariate regression analysis should be applied to control for confounding factors like age, co morbidity and education level.

Work is an important aspect of people's social participation, irrespective of their health condition. Staying at work depends on several critical factors and specific interventions may be needed to reinforce OA patients' work ability. To support the work participation of subjects with OA, this issue should be addressed in every contact that health care professionals have with them.

In conclusion, in this review a mild negative effect of OA on work participation was found. Many OA patients may experience difficulties in their work, but they seem to cope with it. However, the longitudinal course of work participation in OA has not been described completely. Considering the need for increasing numbers of people to continue working at a higher age, this issue needs attention in well-designed studies and in clinical practice.

APPENDIX

Criteria list with operationalization.

Study population

a) Study population: positive if there is no disproportionate inclusion of either relatively healthy patients or patients with severe complaints.

b) Source population: positive if this was described in terms of place of recruitment (e.g. Amsterdam, the Netherlands), time-period of recruitment and sampling frame of source population. Negative if ≤ 2 features of the source population are given.

c) Relevant inclusion and exclusion criteria: positive if these have been described.

Determinant: OA

d) Standardized or valid OA diagnosis: positive if OA is diagnosed by physician and/or by radiology.

e) Potential prognostic factors included: positive if the report describes beside the socio-demographic factors (age and gender) at least one other factor of the following at baseline:
1) Highest education level
2) Physical/disease factors (e.g. severity of pain, stiffness and disability)
3) Job type (white/blue collar, branche)
4) Co-morbidity
5) Insurance system related factors (e.g. financial compensation, litigation)

f) Standardized or valid measurements of the potential prognostic factors: positive if at least one of the factors of e), excluding age and gender, are reported in a standardized or valid way (for example by means of a questionnaire, a diary, an objective measurement [e.g. WOMAC, Insurance Data Base])

g) Data presentation of most important prognostic factors: positive if frequencies, or percentages or mean (and standard deviation/CI), or median (and Inter Quartile Range) are reported for the three most important prognostic factors of e) namely age, gender and at least one other factor, for the most important follow-up measurements.

Outcome: e.g. work participation, sick leave

h) Relevant outcome measures: positive if besides 'complaints' in terms of symptoms (e.g. pain) at least one other outcome criterion for 'participation, sick leave, etc.' is reported, such as:
1)Having a paid job (or not)
2)Lost days of work or return to work
3)Work adaptations (changing job/work hours/work place/etc.)
4)Early retirement
5)Difficulties getting/keeping a job

i) Standardized or valid measurements of outcome measures: positive if one or more of the main outcome measures of h) (having a job/lost days of work) are reported in a standardized or valid way (for example by means of a questionnaire, a diary or an objective outcome measure such as registration of lost working days or receiving work disability compensation according to a register/database).

j) Data presentation of most important outcome measures: positive if frequencies, or percentages or mean (and standard deviation/CI), or median (and Inter Quartile Range) are reported for one or more of the main outcome measures for the most important follow-up measurements.

Analysis

k) Appropriate multivariate analysis: positive if appropriate multivariate techniques are used, such as logistic regression analysis or survival analysis for dichotomous outcomes, or linear regression analysis for continuous outcomes. Negative if no multivariate techniques are performed at all.

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Chapter 3

Work participation and health status in early osteoarthritis. A comparison between the Cohort Hip and Cohort Knee and the Osteoarthritis Initiative.

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ABSTRACT

Objective

To examine the work participation of Dutch people with early osteoarthritis (OA) in hips or knees, and to compare this with data from the American Osteoarthritis Initiative (OAI) cohort. Additionally, the influence of health status and personal factors on work participation was analysed.

Methods

In the Cohort Hip and Cohort Knee (CHECK study) 1002 subjects were included. Baseline questionnaire data from 970 subjects were analysed. Rate ratios were calculated to compare work participation with the general Dutch population, after correcting (by stratifying) for age, sex and education. Health status was measured using the Short Form 36 health survey (SF-36) and the Western Ontario and McMasters Universities Osteoarthritis Index (WOMAC). Groups were compared (CHECK versus OAI, workers versus non-workers) using t-tests.

Results

The mean age of the subjects was 56 years and 79% were females. Overall participation was 51%, similar to the general Dutch population and lower than in OAI (77%). Point prevalence of sick leave because of hip/knee symptoms was 2%, year prevalence was 12%. Of the subjects, 14% had made work adaptations. Workers reported significantly better health status (corrected for age, sex and education) than nonworkers.

Conclusion

Work participation of Dutch people with early OA is similar to the general population and significantly lower than of American subjects. Increasing age, female sex and lower education level were related to lower participation. Societal factors appear to have had more effect on work participation than health status in this stage of OA. The better health status of workers could not be explained solely by selection bias, but may be a result of work.

INTRODUCTION

Participation in paid work is an important aspect of life. Mutual relations have been described between peoples' health, chronic disease and participation in paid work [1]. Inflammatory rheumatic diseases are known to have a strong impact on patients' ability to work [2-5]. Various aspects of workforce participation can be affected, from requiring more assistance at paid work to withdrawal from the workforce. Not only disease aspects, but also personal characteristics and job factors have an influence on work ability. The incidence of permanent work disability among people with rheumatoid arthritis for example is high, but appears to have been declining over the last decades. Reasons for this decline are probably more effective pharmacologic therapy [6], a decrease in physically demanding work [7] and the introduction of preventive and rehabilitative programmes that include attention for behavioral coping [8].
In contrast to inflammatory joint disease, information on work disability in degenerative joint disease is scarce [9]. A number of authors have reported work limitations, sick leave and reduced productivity in people with osteoarthritis (OA) of the hip or knee [10-13]. Because there is no cure and therapeutic opportunities for people with OA are limited, identification of risk factors and prevention of disabilities are important. Furthermore, the need across Europe and other Western societies to continue employing the older workers [9] legitimates attention for the impact of hip and knee OA on work (dis)ability and participation. These issues are, therefore, subject of study in the Cohort Hip and Cohort Knee (CHECK). Wesseling et al [14] described the CHECK population at baseline and characterized them as being in a very early disease phase. They compared them to relevant subpopulations of the American Osteoarthritis Initiative (OAI) in order to provide a basis for further research and comparison of both cohorts.

The current study was performed to answer the following questions:

1. what is the participation rate in paid work of Dutch sujects with early OA of hip and knee?,
2. does work participation of Dutch subjects with early OA differ from the general Dutch population and from Americans with early OA?,
3. have subjects been on sick leave because of symptoms of their hip and knee or because of other health problems?,
4. have subjects made work adaptations because of symptoms of hip and/or knee and were these adaptations related to job type?
5. are there differences in personal characteristics and health status between subjects with paid work and subjects with out paid work?

METHODS

Design

An inception cohort was formed of 1002 participants with pain and/or stiffness of hip and/or knee (CHECK [14]), with participants to be followed prospectively for 10 years. Ten medical centers in the Netherlands participated: Academic Hospital Maastricht; Erasmus Medical Center Rotterdam; Jan van Breemen Institute/VU Medical Center Amsterdam; Kennemer Gasthuis Haarlem; Martini Hospital Groningen/Allied Health Care Center for Rheumatology and Rehabilitation Groningen; Medical Spectrum Twente Enschede/ Twenteborg Hospital Almelo; St. Maartenskliniek Nijmegen; Leiden University Medical Center; University Medical Center Utrecht and Wilhelmina Hospital Assen. The medical ethics committees of all centers approved the cohort study and all participants gave written informed consent before entering the study. This paper describes a cross-sectional study that was performed at baseline in the cohort (the year 2005 for most participants).

Study population

An individual was eligible for inclusion if he or she had pain and/or stiffness of hip and/or knee, was aged 45-65 years and had consulted the general practitioner for these symptoms for the first time ≤6 months ago. Exclusion criteria were pathological conditions other than OA that explained the existing symptoms, other rheumatic disease, previous hip or knee joint replacement, congenital dysplasia, osteochondritis dissecans, intra-articular fractures, septic arthritis, Legg-Calvé-Perthes disease, ligament or meniscus damage, plica syndrome, Bakers cyst, severe comorbidity, malignancy in the last 5 years and inability to understand the Dutch language.

Measurements

Subjects were classified according to the Kellgren/Lawrence (K/L) rating score for radiological OA [15]. All other data in this study were collected from a comprehensive self administered questionnaire (in Dutch) that was composed of a set of validated questionnaires. Several aspects of work participation (present or last job, work hours, working history, present working status, sick leave) were inquired with the questionnaire Economic Aspects in Rheumatoid Arthritis [16]. Labor force participation was defined

as having a paid job for ≥8 hours per week. Participants with paid employment were asked about their present condition and whether they had adapted or would like to adapt their work (tasks/hours/workplace). Subjects without paid work were asked for reasons for not having a job.

Self-reported health status was measured using the Short Form-36 Health Survey (SF-36, [17]) and the Western Ontario and MacMasters University Ostearthritis Index (WOMAC [18;19]). The SF-36 consists of 4 physical subscales and 4 mental subscales with a score range of 0-100, where 100 = the best health situation. The physical component score (PCS) and the mental component score (MCS) were calculated as weighed means of the 4 physical and 4 mental subscale scores, respectively. The PCS and MCS were transformed into norm-based scores that have a normal distribution with a mean of 50 points and an SD of 10 points in the reference population [20]. WOMAC has a total score range of 0-96, where 96 = the worst health situation (maximal restrictions). The total score is a summation of the scores on 3 subscales, for pain (0-20), stiffness (0-8) and physical function (0-68).

The Osteoarthritis Initiative (OAI)

The data from the OAI were obtained from their database, which is available for public access online at http://www.oai.ucs.edu/ [21]. The OAI is a multi-center observational study with a followup of 4 years focusing primarily on knee OA. For comparison with CHECK we logically proceeded on the same data as Wesseling et al. [14], i.e. the data of the subcohort without symptomatic knee OA, but selected on the basis of having specific characteristics that give them an increased risk of developing incident symptomatic knee OA (the incidence cohort). The baseline data on the clinical and joint status of subjects and on risk factors for the progression and development of knee OA were collected by questionnaires and examination. Based on the inclusion criteria for the CHECK study, a subgroup of the incidence cohort was selected that was comparable with the CHECK cohort: participants were aged 45-65 years, had frequent or infrequent knee symptoms and had no surgery in either knee (n=1578).

Statistical analysis

The results of the CHECK questionnaire about work participation were compared with data from the general population [22]. Work participation rate ratios (CHECK/general population) with 95% confidence intervals (95% CIs) were calculated. If a 95% CI includes the value of 1.0 this indicates that there is no statistically significant difference between the rates ($P < 0.05$). To correct for confounding by age, sex and education level the data were stratified for these factors [2]. Age was stratified into 4 5-year groups. The highest attained education level was divided in 3 categories: primary, secondary and higher education. Data on cells with ≤5 subjects were not presented because the information might have been personally identifiable and valid interpretation would have been difficult.

For subjects with paid employment, frequencies of sick-leave (point prevalence and 12-months prevalence) and work adaptations (actualized and desired) were described. Frequencies of work adaptations were described for 6 categories of job type: crafts/industry, transport, administrative, commercial, service and other. Differences in self-reported health status (SF-36 and WOMAC) between working and nonworking subjects (both CHECK and OAI) were tested using t-tests. To control for confounding by age and sex, data were also stratified for these factors and 95% CIs were calculated.

RESULTS

Subjects

In total, 1002 subjects were included in the CHECK cohort study [14] and participated in the current study. Regarding work participation, 970 questionnaires were filled out completely and used for analysis (97% response rate). The mean + SD age of the subjects was 56 + 5 years, and 79% were females. Of the respondents, 41% percent had knee symptoms only, 17% hip symptoms only, and 42% had symptoms of both the hip and knee. Based on the classification by the K/L rating score [15] the proportion of subjects with radiological osteoarthritis (K/L grade >1) was 7% for the knee and 6% for the hip, indicating that CHECK is indeed an early OA cohort. However, 76% of the patients with knee symptoms could be diagnosed as OA according to the American College of Rheumatology (ACR; formerly the American Rheumatism Association) clinical criteria for classification of OA [23]. Only a minority of CHECK participants with hip symptoms (24%) fulfilled the ACR clinical classification criteria for hip OA [24]. The proportion of subjects in the OAI with K/L grade >1 was 40%.

Work participation

Of all 970 subjects, 493 reported having a paid job for ≥8 hours weekly. This represents an overall work participation of 51% (60% in men, 48% in women). The proportion of subjects working ≥24 hours was 27%, the other 24% had smaller part-time jobs; 13% worked more than 36 hours. Comparison of the work participation for subgroups in CHECK with the general Dutch population is presented in Table 1.

The overall work participation in the OAI was 76% (82% in men, 75% in women). In all strata, the work participation of men was higher compared with that of women. Work participation decreased with age and was higher among participants with higher education levels. A valid comparison between CHECK and the general population in the primary school education category was not feasible, because in CHECK there were only 6 men and 16 women in this category. For subjects with secondary and higher education, the participation rates were similar to those of the general population (all 95% CIs include the value of 1 for the ratios), with a tendency to be somewhat lower in the highest age group.

Of the subjects, 38 (7.7% of the working subjects) reported being on sick leave at the time that they completed the questionnaire, 10 because of hip/knee symptoms (point prevalence of 2.0% of the workers). In the past 12 months, 61 subjects had been on sick-leave because of their hip or knee symptoms (year prevalence of 12.4%). The frequencies of sick leave duration were distributed evenly over the categories of <1 week, 1-2 weeks, 2-4 weeks, 1-3 months and >3 months.

	Men			Women		
Age groups, years	CHECK rate, % (†)	Dutch rate, %	Rate ratio, (95% CI)	CHECK rate, % (‡)	Dutch rate, %	Rate ratio, (95% CI)
Primary school	(6)			(16)		
45-49	§	83	-	- (-)	50	-
50-54	§	75	-	80 (5)	39	2.0 (1.0-3.0)
55-59	§	66	-	43 (7)	25	1.7 (0-3.7)
60-64	§	22	-	§	6	-
Secondary school						
45-49	94 (16)	87	1.1 (0.5-1.6)	78 (74)	69	1.1 (0.9-1.4)
50-54	85 (40)	83	1.0 (0.7-1.4)	61 (137)	61	1.0 (0.8-1.2)
55-59	71 (35)	71	1.0 (0.6-1.4)	42 (201)	41	1.0 (0.8-1.2)
60-64	16 (38)	26	0.6 (0.1-1.1)	14 (140)	15	1.0 (0.6-1.4)
Higher education						
45-49	100 (7)	92	1.1 (0.3-1.9)	77 (31)	81	1.0 (0.6-1.4)
50-54	100 (10)	90	1.1 (0.4-1.8)	74 (69)	76	1.0 (0.7-1.2)
55-59	71 (24)	77	0.9 (0.5-1.3)	66 (59)	58	1.1 (0.8-1.5)
60-64	(28)	36	0.7 (0.2-1.2)	13 (39)	22	0.6 (0.1-1.1)

(†) Total n = 204.
(‡) Total n = 766.
§ Data not presented because there were <5 subjects.

Table 1:
Work participation rates (%) and ratios, stratified for education level, age, and sex in the CHECK cohort and in the general Dutch population*

* CHECK = Cohort Hip and Cohort Knee; 95% CI = 95% confidence interval.

Work adaptations

Work adaptations that were realized and desired are presented in Table 2.

	Subjects	Total adaptations, no.	Type of work adaptation: Fewer hours	Other / fewer tasks	Work place / aids	Work technique
Work adaptations have been made because of my hip/knee symptoms	67 (14)	77	29 (38)	8 (10)	19 (25)	21 (27)
I would like to have my work adapted because of my hip / knee symptoms	146 (30)	176	61 (35)	43 (24)	48 (27)	24 (14)

Table 2:
Work adaptations made and desired by subjects working ≥ 8 hours per week (n=493)*

* Values are the number (percentage) unless otherwise indicated.

Subjects were allowed to report more than 1 adaptation. Working fewer hours was the most frequently realized and most desired adaptation. Adaptations in work technique involved personal adaptations, such as taking frequent short breaks and the better dividing of effort during a work day. In transport jobs there were no subjects who reported adaptations in their function. Subjects working in crafts/industry and transport desired adaptations more frequently compared with those in other branches (results not presented).

Self-reported health status in workers and nonworkers

The 493 persons working ≥8 hours were labeled as having a job, and the other 477 persons as not having a job. These 2 groups were compared by personal characteristics (age, sex, education level) and on their scores on self-reported health status (SF-36 and WOMAC). The results for both groups and for the whole cohort, as well as the corresponding data for the OAI, are presented in Table 3.

In both cohorts, the group with paid jobs had a significantly lower mean age and a significantly higher proportion of men compared with the group without paid jobs. There were statistically significant differences on the physical scales of SF-36 and on all scales of the WOMAC, with workers scoring better. There were no statistically significant differences on the mental scales of the SF-36. To verify the comparability of CHECK and OAI, the analyses were repeated on the CHECK subjects with exclusion of those with only hip symptoms (17%). Of the 829 subjects with knee symptoms, 50% had a paid job, and the other reported outcome variables did not change or changed only marginally (by some decimal points).

	CHECK: Paid work n=493 (51%)	CHECK: No paid work n=477 (49%)	CHECK: All n=970	OAI: Paid work n=1209 (77%)	OAI: No paid work n=369 (23%)	OAI: All n=1578
Age (years)	53 (5)	58 (5)*	56 (5)	55 (6)	59 (5)*	56 (6)
Men, %	25	17*	21	38	29*	36
Education level %						
Low	2	5	3	2	5	3
Middle	66	71	70	63	70	65
High	32	23	27	35	25	32
BMI, kg/m^2	26.0 (4)	26.4 (4)	26 (4)	28.7 (5)	28.3 (5)	28 (5)
WOMAC scores:						
Pain (0-20)	4.6 (3.3)	5.5 (3.5)*	5 (3)	1.9 (2.7)	2.4 (3.2)*	2.0 (2.9)
Stiffness (0-8)	2.5 (1.6)	2.8 (1.7)*	3 (2)	1.5 (1.6)	1.3 (1.5)*	1.3 (1.5)
Function (0-68)	14.5 (11.0)	17.5 (12.1) *	16 (12)	5.9 (8.8)	8.4 (11.2)*	6.5 (9.4)
SF-36 scores: (all 0-100)						
Physical Function	77.4 (15)	72.0 (19)*	75 (17)			
Physical Role	74.2 (36)	68.0 (40)*	71 (39)			
Bodily Pain	70.4 (17)	65.4 (18)*	68 (18)			
General Health	55.9 (18)	51.9 (19)*	54 (18)			
Physical Sum Score	47 (8)	44 (9)*	46 (8)	51 (7)	47 (10)*	50 (8)
Vitality	64.9 (16)	63.4 (18)	64 (17)			
Social Function	82.9 (17)	81.3 (19)	82 (18)			
Social Role	88.0 (28)	86.6 (29)	87 (29)			
Mental health	77.3 (14)	75.7 (15)	77 (15)			
Mental Sum Score	53 (9)	53 (9)	53 (9)	53 (8)	53 (9)	53 (8)

Subjects with hip symptoms only reported marginally better on some variables, including work participation (53%). The CHECK cohort reported higher scores (worse health) on the pain, stiffness and function subscales compared with the OAI. Many differences between workers and nonworkers in CHECK remained or even increased within the strata [Table 4]. Statistically significant differences were found mostly in women 50-54 years of age (3 scales) and 55-59 years of age (3 scales) and in men 60-64 years of age. In all of these cases, the workers reported better health than the nonworkers.

Table 3:
Comparison of subject characteristics and self-reported health status between groups paid work and no paid work, in CHECK and OAI, all tested with independent t-tests*

Values are the mean ± SD unless otherwise indicated. CHECK: Cohort Hip and Cohort Knee; OAI Osteoarthritis Initiative; BMI: body mass index; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; SF-36: Short Form 36 health survey.

* $P < 0.05$ for difference between paid work and no paid work.

Outcome	Age 45-49 Paid work No n=1 man n=23 women	 Yes n=23 men n=82 women	Age 50-54 Paid work No n=6 men n=73 women	 Yes n=44 men n=138 women	Age 55-59 Paid work No n=17 men n=141 women	 Yes n=43 men n=126 women	Age 60-64 Paid work No n=57 men n=158 women	 Yes n=13 men n=25 women
SF-36								
Physical Function								
Men	#	79.6 (73.7-85.4)	67.5 (42.5-92.5)	77.2 (73.1-81.2)	77.2 (66.2-88.2)	79.5 (74.1-84.9)	77.3 (73.5-81.0) ¥	85.8 (81.5-90.0) ¥
Woman	71.1 (62.8-79.4)	77.6 (74.3-80.9)	65.7 (60.4-71.0) ¥	75.2 (72.6-77.9) ¥	72.1 (69.1-75.1) ¥	78.3 (75.5-81.1) ¥	72.9 (70.2-75.6)	73.8 (67.2-80.4)
Role Physical								
Men	#	77.1 (63.5-90.6)	33.3 (0-72.8)	80.7 (70.9-90.5)	75.5 (56.0-95.0)	81.1 (71.0-91.2)	83.8 (75.8-91.7)	80.8 (63.2-98.4)
Woman	53.3 (34.7-71.8)	71.3 (62.6-79.9)	54.9 (44.6-65.1)	70.9 (64.4-77.4)	70.0 (63.4-76.7)	76.6 (70.3-82.9)	69.4 (63.3-75.5)	61.5 (42.0-80.9)
Pain								
Men	#	74.5 (69.2-79.8)	54.8 (31.8-77.7)	70.6 (65.8-75.4)	71.4 (61.5-81.4)	73.8 (67.8-79.9)	72.1 (68.2-76.0)	82.1 (72.9-91.3)
Woman	58.2 (48.4-68.0)	70.1 (66.4-73.8)	61.1 (56.8-65.4) ¥	68.3 (65.4-71.3) ¥	64.3 (61.6-67.0) ¥	70.7 (67.8-73.7) ¥	67.1 (64.3-69.8)	63.9 (57.3-70.5)
General Health								
Men	#	56.3 (50.6-61.9)	37.5 (1.3-73.7)	54.0 (49.7-58.3)	47.1 (39.3-54.8)	56.4 (50.6-62.2)	57.9 (53.3-62.4)	59.6 (46.5-72.8)
Woman	48.9 (42.0-55.8)	56.1 (52.3-59.9)	45.5 (41.2-49.9) ¥	54.0 (51.0-57.0) ¥	52.3 (49.3-55.3)	58.1 (54.8-61.4)	53.9 (51.1-56.6)	54.0 (47.6-60.4)
WOMAC:								
Pain								
Men	#	4.4 (2.9-5.9)	5.8 (1.1-10.6)	3.9 (3.1-4.7)	4.4 (2.4-6.3)	4.1 (3.1-5.1)	5.0 (4.2-5.7)	4.2 (2.3-6.0)
Woman	5.7 (3.9-7.4)	4.6 (3.9-5.2)	6.1 (5.2-7.0)	5.0(4.4-5.5)	5.6 (5.0-6.2)	4.5 (3.9-5.2)	5.5 (5.0-6.1)	5.5 (4.3-6.7)
Stiffness								
Men	#	2.2 (1.5-2.9)	3.7 (2.0-5.4)	2.8 (2.4-3.2)	2.3 (1.5-3.1)	2.3 (1.8-2.8)	2.6 (2.2-3.1)	2.1 (1.5-2.7)
Woman	3.0 (2.3-2.8)	2.2 (1.9-2.6)	2.9 (2.5-3.3)	2.7 (2.5-3.0)	2.9 (2.6-3.2)	2.5 (2.2-2.8)	2.7 (2.4-3.0)	2.3 (1.6-3.0)
Function								
Men	#	12.0 (8.1-16.0)	20.0 (4.0-36.0)	13.7 (10.6-16.7)	14.1 (7.2-21.2)	14.2 (10.2-18.1)	14.6 (12.1-17.1)	8.4 (3.8-13.0)
Woman	17.7 (11.7-23.7)	14.0 (11.7-16.2)	19.5 (16.2-22.7)	16.2 (14.2-18.2)	18.0 (16.1-19.9) ¥	14.1 (12.2-16.1) ¥	17.5 (15.6-19.2)	15.3 (11.7-19.0)

Table 4:
Stratified comparison of SF-36 (physical scales) and WOMAC scores between the paid work and no paid work groups in CHECK *

* Values are the mean scores (95% CI)
# Data not presented because there were less than 5 subjects in these cells
¥ Statistically significant difference

DISCUSSION

This study demonstrates that the work participation of people in CHECK was similar to that in the general Dutch population, and lower compared with that in the OAI cohort. The self-reported health status of the subjects with a paid job was slightly better than that of the subjects without a job, both in CHECK and the OAI cohort. A small proportion of the working subjects had made work adaptations because of their symptoms; one third of them wanting their work to be adapted.

Work participation in the CHECK cohort decreased with age, female sex and lower education level, which justifies the stratified analysis even though it resulted in a number of cells with small frequencies. Participation rates in the CHECK cohort were similar to those in the general Dutch population. Bias could have occurred from the Dutch statistics bureau (CBS) definition of work participation as having a paid job for ≥12 hours weekly, whereas the CHECK questionnaire asked for working ≥8 hours weekly. This means that the results of this study may reflect a slight overestimation of the work participation in the cohort. Moreover, the proportion of subjects in part-time work was high and jobs with a high physical work load seem to have been underrepresented in our study, which may be related to the relatively high education level of the subjects.

Comparisons of figures on work participation between countries are sensitive to bias by such external factors as legislation and labour market conditions. For example, the organization of benefits and facilities to help the worker find or return to work vary between countries [9]. From this perspective the difference in work participation in our study, 51%, and in the OAI, 77%, was remarkably large. Overall, 36 (7%) of the 493 nonworkers in our cohort indicated that health problems were their reason for not working. The comparison of the cohorts regarding clinical and personal characteristics indicated that radiographic joint damage was clearly more outspoken in the OAI cohort, but that the CHECK subjects presented more pain, stiffness and problems in function. Wesseling et al [14] hypothesized that CHECK was started in an even earlier phase of OA than the OAI, a phase that is not accompanied by radiographic findings. The OAI subjects were in a subsequent phase, coping with pain and disability, which may explain a decrease in reports on these characteristics while changes in anatomical structures were developing.

Not the clinical differences between the cohorts, but differences in social and economic factors of the Dutch and American societies are the most likely explanation for the observed difference in work participation. The point prevalence for sick leave of 7.7% in our study was slightly higher than the average prevalence in the Dutch population, which was 5.5% for workers aged 45-65 years [22]. Sick leave prevalence is known for its variation, e.g. between seasons and between branches. One third of the sick-leaves in CHECK were due to hip and knee symptoms, which seems relatively high. As mentioned in our introduction, the impact of RA on work ability is high (32 % sick leave [6]) and compared with this, the effect of early OA appears much more moderate. It must be noticed that no conclusions can be drawn on the effects in people with more progressed OA.

To explore the need for preventive measures in the early stage of OA, subjects were asked about realized and desired work adaptations. Working fewer hours was the most frequently mentioned adaptation. This suggests that a number of subjects were not able to cope with their decreased self-reported work capacity and that other ways of adapting the work load were difficult to achieve. Considering the expressed desire for work adaptations as well as the contribution of hip and knee symptoms in the reported sick leave in this early stage of OA, an increase of problems faced by these workers may be anticipated. To facilitate work continuation of this group it is important that they express this need and that preventive interventions [25] are considered seriously by their employers. Research is needed to explore the opportunities for interventions aimed at the prevention of work disability and factors that influence the effectiveness of these interventions.

The self-reported health status (WOMAC score) of workers in CHECK as well as in OAI was statistically significantly better than of nonworkers. A similar pattern emerged from the 4 physical SF-36 subscales. These differences persisted after correction for sex and age, and occurred similarly in subjects with knee symptoms and in the subgroup with only hip symptoms. Taking the physical function

subscale as an example, the mean differences were 9.5 points (50-54 year old women) and 6.2 points (55-59 year old women) on a scale of 0-100. Because this scale is constructed of 10 questions with answering options "no/minor/major restrictions", corresponding with 0, 5 and 10 points, respectively, this means that workers had 1 or 2 minor restrictions or 1 major restriction fewer. The health differences between workers and nonworkers appeared much smaller in patients with early OA compared with patients with RA [2], although comparison is difficult due to differences in study design and patient recruitment between studies. However, because all subjects in our cohort were recruited because of recent complaints, sickness duration can not be an explanation for the observed differences in our study. The clinical relevance of the differences is a challenging subject for discussion, both in relation to interventions, as discussed before, and related to explanatory mechanisms.

Two explanations seem feasible for the differences in health status between the workers and nonworkers in the cohort. On one hand it could be a healthy worker effect [26]. In occupational medicine this is mostly considered to be a form of selection bias: part of the people have given up work because of health problems, so the remaining workers are healthier. However, only a small proportion in our cohort reported not working because of being partially or completely work disabled (and very few of whom because of hip or knee problems). On the other hand, having a job may have had a beneficial effect on our working subjects' health. This hypothesis is supported by the observation that the recently retired subjects had health scores similar to those of the subjects with paid work. However, considering the cross-sectional design of this study, confirmation of either proposition remains to be seen from follow-up measurements.

In conclusion, at baseline in the cohort study, our subjects appeared to be similar to the general Dutch population with regard to most aspects of work participation. Small differences in health status between workers and nonworkers were observed, which indicate a relation within the Dutch society between health and functional status and work participation. Comparison with the OAI suggests that differences in societal aspects, e.g. the health insurance system or the free choice of people to do paid work or not, had a strong additional influence on this relation. The Dutch social system apparently allows persons with mild functional limitations not to have paid work at a relatively young age, whereas the USA stimulates them to work. Followup analyses will be aimed at identifying predictive factors in the relation between work and health.

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Chapter 4

The course of work participation in early osteoarthritis. A 2-years follow-up study in the Cohort Hip and Cohort Knee (CHECK).

Submitted

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ABSTRACT

Objectives

To document the course of work participation from baseline (T_0) to 2-years follow-up (T_2) in the Cohort Hip and Cohort Knee (CHECK) study on early osteoarthritis (OA) of hips or knees; to compare baseline and process characteristics of subjects who continued working and subjects who stopped working. Furthermore, to compare sick leave and work adaptations at T_2 to T_0.

Methods

Questionnaire data from 925 subjects were analyzed. Rate ratios were calculated to compare work participation with the general Dutch population, corrected for age, sex and education. The overall participation rate at T_2 was compared to T_0. Personal factors, self-reported health status (ShortForm-36 – SF36, Western Ontario McMasters Osteoarthritis Index - WOMAC), medical consumption and physical work demands were compared between subjects who continued working and subject who stopped working; factors that differed significantly were included in a logistic regression analysis.

Results

Work participation in the cohort (mean age 58, 79% females) decreased from 51% to 46%, similar to the general population. Subjects who stopped working were older than those who continued working (mean 4.2 years) and more frequently reported sick-leave at baseline; the regression model also included both factors. 11% Of the workers reported sick-leave in the past year because of hip/knee complaints (similar to baseline). 20% Reported work adaptations, compared to 14% at baseline.

Conclusion

The 2-years course of work participation of people with early OA was similar to the general Dutch population. Leaving the work force was related to higher age, not to OA related factors.

INTRODUCTION

Arthritis is frequently reported to be one of the most disabling diseases, causing a high socioeconomic impact [1,2]. When discussing the impact of arthritis authors often draw conclusions on both rheumatoid arthritis (RA) and osteoarthritis (OA), although there is much more information on RA than on OA in this respect [3]. The financial burden of these diseases consists of direct health care expenses and indirect costs, for example due to reduced work productivity and absenteeism [4-6]. Regarding future demands on the health care system, osteoarthritis is often labeled as one of the diseases with the highest impact, because of its increasing prevalence in societies faced with ageing populations and higher proportions of overweight people. However, in most studies only small numbers of subjects with OA in the working age have been included and this raises questions about the validity of findings concerning the effect of OA on work.

Well documented information on the impact of OA on work participation is scarce [7]. Differences in study design and populations, as well as international differences in systems of health insurance and social security, make it difficult to get insight in the impact of OA on work participation. Patients, employers and health care professionals need this insight to develop evidence based strategies and interventions that can support individuals with OA to stay at work. Paid work is an important aspect of social participation [8,9] and a contribution to society with an increasing economic necessity. Therefore, factors which determine work participation or which precede leaving the work force need to be identified. The main objectives of this 2-years follow-up (T_2) study in the Cohort Hip and Cohort Knee (CHECK) on early OA were to document the longitudinal course of work participation and to identify differences in characteristics between subjects who continued working and subjects who stopped working.

Study questions were:

- Were there differences in work participation between the CHECK cohort at T_2 and the general Dutch population, controlled for age, sex and education level?
- Has the work participation in the cohort changed from baseline to T_2 follow-up?
- Were there differences in personal characteristics, self reported health status, medical consumption and work demands between people in the cohort who continued working at two years follow-up compared to people who stopped working?
- Were the prevalence of sick leave and of work adaptations in the subjects with paid work at T_2 different from baseline (T_0)?

METHODS

Design

An inception cohort was formed of 1002 participants with pain and/or stiffness of hip and/or knee (CHECK – Cohort Hip and Cohort Knee) [10] for a 10 year prospective study. Ten medical centers in the Netherlands participate. The medical ethics committees of all centers approved the cohort study and all participants gave written informed consent before entering the study. In this paper 2-year follow up data are presented (T_2; the year 2007 for most participants) and by comparison with baseline (T_0) data [11] the course of work participation, sick-leave and work adaptations were described.

Study population

An individual was eligible for inclusion in the cohort if he or she had pain and/or stiffness of hip and/or knee, was aged 45-65 years and had no longer than 6 months ago (at baseline) consulted the general practitioner for these symptoms for the first time. Exclusion criteria were: other pathological condition than OA that explained the existing complaints, other rheumatic disease, previous hip or knee joint replacement, congenital dysplasia, osteochondritis dissecans, intra-articular fractures, septic arthritis, Perthes' Disease, ligament or meniscus damage, plica syndrome, Bakers cyste, severe co-morbidity, malignancy in the last 5 years and inability to understand the Dutch language.

Measurements

Subjects were classified according to the Kellgren & Lawrence (K&L) rating score for radiological OA [12] at baseline and at T_2. All other data in this study were collected at both measurements from a comprehensive self administered questionnaire (in Dutch) that was composed of a set of validated questionnaires. Several aspects of work participation (present or last job, work hours, working history, present working status, sick leave, physical work demands) were inquired with the questionnaire 'Economic Aspects in Rheumatoid Arthritis'[13]. Labour force participation was defined as having a paid job for 8 hours or more per week. Participants with paid employment were asked if they had been on sick leave, and if so, if this was because of hip/knee complaints or for other health reasons. Another question was whether they had adapted or would

like to adapt their work (hours, tasks, workplace). Subjects without paid work were asked for reasons for not having a job.

Self-reported health status was measured using the Short Form-36 Health Survey (SF-36, [11,14,15]) and the Western Ontario and McMasters University Arthritis Index (WOMAC [16,17]). The SF-36 consists of 8 subscales with a score range of 0-100, the maximum score of 100 indicates the best health situation. The WOMAC has a total score range of 0-96, the maximum score of 96 indicates the worst health situation (maximal restrictions). The total score is a summation of the scores on 3 subscales, for pain (0-20), stiffness (0-8) and physical function (0-68).

Regarding medical consumption, subjects were asked to indicate whether they had visited any professionals from a list of health care professions.

Analysis

The results of the CHECK questionnaire on work participation were compared with data from the general Dutch population [18]. Work participation rate ratios (CHECK/general population) with 95% confidence interval (CI) were calculated for subjects not older than 65 years. If a CI included the value of 1.0 this indicated that there was no statistically significant difference between the rates ($p< 0.05$). To correct for confounding by age, sex and education level, the data were stratified for these factors. Age was stratified into groups of 5 years, in accordance with the population data. The highest attained education level was divided in 3 categories: primary, secondary and higher education.

The course of work participation in the cohort was described by comparing the calculated T_2 outcome with the T_0 outcome. To identify explanatory factors for the course, that is either remaining at work or leaving the work force, age, sex, education level and Body Mass Index (BMI), self-reported health status, medical consumption and physical demands of the respective groups of subjects were compared. Independent t-tests were used for the continuous variables, applying Bonferroni correction for multiple comparison, Chi^2 test for frequencies (Fisher exact in case of cells with less than 5 expected). Differences between T_2 and T_0 within the groups were tested using

paired t-tests. Variables on which significant differences between the groups were found, were included simultaneously in a multivariate logistic regression analysis to examine relationships with leaving the work force. The backward LR method was used and goodness-of-fit was tested with the Hosmer-Lemeshow test.

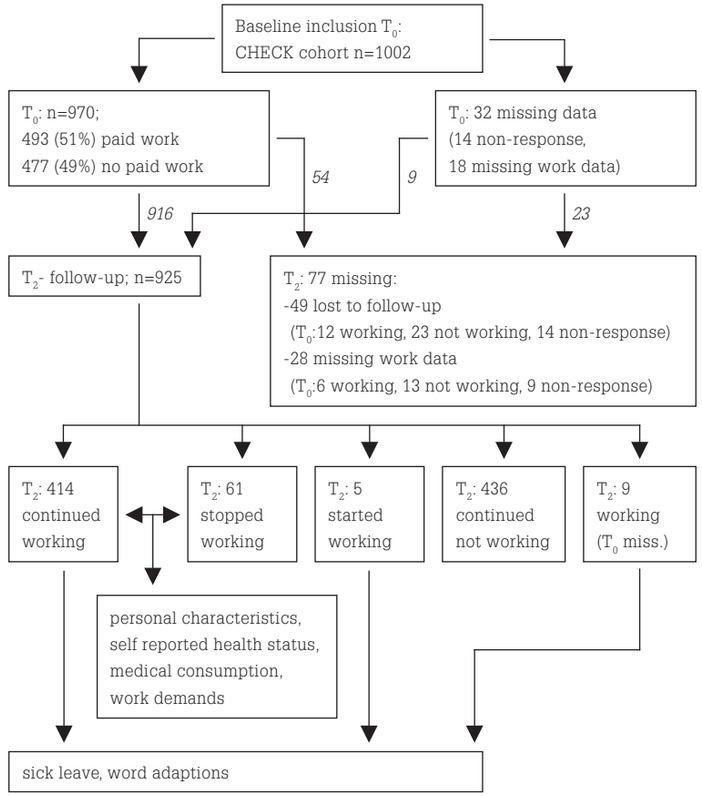
For subjects with paid employment the point prevalence of sick-leave (at moment of filling out the questionnaire) and the incidence of sick-leave during the past 12 months were determined at T_2, as well as the frequency of work adaptations (actualized and desired), and compared to baseline.

RESULTS

Subjects

925 Subjects filled out the sections on work in the questionnaire at 2-year follow-up, compared to 970 at baseline [Figure 1].

Figure 1:
Flow diagram of the study design



Mean age of the subjects at T_2 was 58 years, 79% were females. Among the subjects 41% had knee complaints only, 17% had only hip complaints, 42% had complaints of both hip and knee. Based on the classification by the Kellgren & Lawrence (K&L) rating score [12] the proportions of subjects with radiological osteoarthritis (K&L>1) of the knee at T_0 and T_2 were 4% and 6%, respectively, and 7% and 12% for the hip, indicating that CHECK is indeed an early OA cohort. However, 76% of the patients with knee symptoms could be diagnosed as OA according to the clinical ACR criteria for classification of OA [19]. Only a minority of CHECK participants with hip symptoms (24%) fulfilled the clinical classification criteria of hip OA [20].

Work participation for subgroups in CHECK compared to the general population is presented in Table 1. For subjects with secondary and higher education the participation rate in CHECK was similar to the general population (all 95% CI's included the value of 1 for the ratio's). A valid comparison of the group with primary school was not feasible, because there were only six males and 18 females in the cohort with this education level. In all but one of the strata (higher educated subjects older than 65) work participation of males was higher compared to females. Work participation decreased with age and was higher in higher education levels. Of the 125 subjects with an age over 65, seven (6%) reported still doing paid work. Since the Dutch statistics assume that people retire at an age of 65, this figure could not be compared.

Table 1:
Work participation rates (%) and ratios, stratified for education level, age and sex in the CHECK cohort at 2-year follow-up and in the general Dutch population.

	Males			Females		
	CHECK rate % (n)	Dutch rate %	rate ratio (95% CI)	CHECK rate %(n)	Dutch rate %	rate ratio (95% CI)
Primary school						
age 45-49	-(-)	81	-	-(-)	49	-
50-54	100(2)	78	1.28(0-3.79)	50(2)	42	1.19(0-3.52)
55-59	100(1)	67	1.49(0-4.42)	50(8)	29	1.72(0.03-3.41)
60-64	33(3)	24	1.39(0-4.11)	25(4)	8	3.13(0-9.25)
> 65	-(-)			25(4)		
Secondary school						
age 45-49	100(6)	87	1.15(0.23-2.07)	90(29)	72	1.25(0.77-1.72)
50-54	91(32)	86	1.05(0.67-1.44)	69(112)	65	1.06(0.82-1.29)
55-59	61(38)	74	0.82(0.48-1.15)	44(167)	50	0.89(0.68-1.09)
60-64	39(31)	30	1.29(0.56-2.02)	18(136)	15	1.23(0.75-1.71)
> 65	0(17)			3(71)		
Higher education						
age 45-49	100(5)	93	1.08(0.13-2.02)	78(9)	83	0.94(0.24-1.64)
50-54	100(8)	91	1.10(0.34-1.86)	74(43)	79	0.94(0.62-1.27)
55-59	63(16)	79	0.79(0.30-1.29)	72(76)	63	1.15(0.85-1.45)
60-64	32(25)	34	0.94(0.29-1.59)	28(47)	25	1.11(0.50-1.71)
> 65	8(13)			15(20)		
	197			728		

Table 2:
Comparison of personal factors, health status, health care consulting, sick leave and work demands of subjects still working and subjects who stopped working, both at T_0 and T_2

* P < 0.05

		Still Working n=414		Stopped Working n=61		Stopped - Still working	
		Mean (SD)		Mean (SD)		Mean difference (95% CI)	
Sex (female)		75%		74%			
Age	T_0	53.0	(4.2)	57.2	(3.6)	4.2	(3.1 to 5.3) *
	T_2	55.1	(4.3)	59.3	(3.6)	4.2	(3.1 to 5.3) *
	Diff T_2-T_0	2.1	(0.4) *	2.1	(0.8) *	0	
BMI	T_0	25.9	(3.8)	26.2	(3.6)	0.3	(-0.7 to 1.3)
	T_2	25.9	(3.9)	26.1	(3.9)	0.2	(-0.8 to 1.3)
	Diff T_2-T_0	0		-0.1		-0.1	
SF-36							
Physical Function	T_0	77.5	(15.0)	77.1	(17.4)	-0.4	(-4.5 to 3.7)
	T_2	77.3	(17.5)	76.6	(19.4)	-0.8	(-5.5 to 4.0)
	Diff T_2-T_0	-0.2		-0.5		-0.2	(-4.4 to 3.9)
Social Function	T_0	83.6	(17.1)	79.8	(17.5)	-3.8	(-8.4 to 0.8)
	T_2	82.8	(19.0)	82.5	(20.5)	-0.4	(-5.6 to 4.8)
	Diff T_2-T_0	-0.8		2.7		3.5	(-1.7 to 8.7)
Physical Roles	T_0	75.1	(36.4)	74.6	(38.1)	-0.5	(-10.3 to 9.3)
	T_2	77.5	(35.4)	75.8	(36.8)	-0.7	(-10.5 to 9.1)
	Diff T_2-T_0	2.3		1.3		-1.0	(-12.1 to 10.0)
Emotional Roles	T_0	89.0	(27.9)	83.9	(31.0)	-5.1	(-12.7 to 2.5)
	T_2	85.7	(31.7)	81.7	(36.3)	-3.7	(-12.6 to 5.2)
	Diff T_2-T_0	-3.3		-2.2		1.0	(-8.6 to 10.6)
Mental Health	T_0	77.5	(14.0)	77.3	(14.9)	-0.2	(-4.0 to 3.6)
	T_2	77.3	(15.4)	77.8	(17.1)	0.4	(-3.8 to 4.7)
	Diff T_2-T_0	-0.2		0.5		0.7	
Vitality	T_0	65.2	(15.2)	65.5	(17.8)	0.3	(-3.9 to 4.5)
	T_2	64.1 (	16.4)	68.4	(17.9)	4.2	(-0.3 to 8.7)
	Diff T_2-T_0	-1.1		2.9		4.0	(0.0 to 8.0)
Pain	T_0	70.7	(16.7)	69.4	(18.8)	-1.3	(-5.9 to 3.3)
	T_2	71.3	(17.9)	72.7	(18.1)	1.3	(-3.5 to 6.2)
	Diff T_2-T_0	0.6		3.3		2.7	(-2.0 to 7.5)
WOMAC							
Pain	T_0	4.5	(3.2)	4.3	(3.4)	-0.2	(-1.1 to 0.7)
	T_2	4.1	(3.2)	4.1	(3.5)	-0.1	(-0.9 to 0.8)
	Diff T_2-T_0	-0.4 *		-0.2		0.2	(-0.6 to 1.1)
Stiffness	T_0	2.5	(1.6)	2.3	(1.7)	-0.2	(-0.7 to 0.2)
	T_2	2.3	(1.7)	2.2	(1.6)	-0.1	(-0.5 to 0.4)
	Diff T_2-T_0	-0.2 *		-0.1		0.1	(-0.4 to 0.5)
Function	T_0	14.1	(10.6)	15.2	(12.4)	1.1	(-1.8 to 4.0)
	T_2	13.3	(11.1)	13.5	(12.0)	0.3	(-2.7 to 3.3)
	Diff T_2-T_0	-0.7		-1.6		-0.9	(-3.4 to 1.6)

		Still Working n=414	Stopped Working n=61	Still working - Stopped
		Proportion:	Proportion:	Mean difference (95% CI)
Contact with:				
General Physician	T_0	38%	34%	-4% (-16% to 9%)
	T_2	9%	7%	-3% (-5% to 1%)
	Diff T_2-T_0	-28% *	-28% *	0 (-14% to 13%)
Physical Therapist	T_0	21%	21%	0 (-11% to 10%)
	T_2	15%	11%	-3% (-5% to 1%)
	Diff T_2-T_0	-6% *	-10%	-4% (-16% to 8%)
Rheumatologist	T_0	7%	7%	0 (-6% to 7%)
	T_2	2%	3%	1% (-3% to 5%)
	Diff T_2-T_0	-5% *	-3%	2% (-6% to 9%)
Orthopedic	T_0	4%	5%	1% (-5% to 6%)
	T_2	6%	2%	-4% (-10% to 2%)
	Diff T_2-T_0	2%	-3%	-5% (-3% to 12%)
Occupational physician	T_0	0%	0%	0
	T_2	4%	2%	-2% (-8% to 3%)
	Diff T_2-T_0	4%	2%	-2% (-3% to 8%)
At sick leave now		Numbers:	Numbers:	
	T_0			
No		381	49	Chi^2=17;
Yes, because Hip/Knee		8	2	P=0.000 *
Yes, other complaints		16	10	
Been at sick leave because of Hip / Knee		Numbers:	Numbers:	
	T_0			
No		362	56	Chi^2=0.5;
Yes		48	5	P=0.316
Education		Numbers:	Numbers:	
	T_0			
Low		10	0	Chi^2=3.0;
Medium		267	43	P=0.37
High		137	18	
Physical demands		Numbers:	Numbers:	
Kneel/squat long	T_0			
Seldom or never		276	37	Chi^2=0.47;
Occasional		87	14	P=0.925
Often		28	4	
(Almost) always		11	1	
Handle heavy loads	T_0			
Seldom or never		297	45	Chi^2=2.7;
Occasional		59	7	P=0.440
Often		25	4	
(Almost) always		16	0	
Knee bending	T_0			
Seldom or never		144	20	Chi^2=0.74;
Occasional		141	20	P=0.864
Often		104	17	
(Almost) always		14	1	

Longitudinal analyses regarding subjects staying in the work force and those dropping out could be described from data on 475 subjects [Figure 1]; 414 (87%) of them remained working and 61 (13%) stopped working; the five subjects (re-)entering the work force were not included here because of their very small number. They were however, just as the additional nine who were missing at baseline, included in the T_2 analyses regarding comparison with the general population, the sick leave and work adaptations. There were 436 subjects who did not have paid work at both measurements. As a result the course of work participation was a decrease from 51% at T_0 to 46% at T_2 (428 out of 925).

The 61 subjects who had stopped working at T_2 were on average 4.2 years older than those who continued working. Ten of them (16%) had reported being at sick-leave at the moment of filling the T_0 questionnaire, because of other complaints than hip or knee, compared to 4% of those who continued working. They did not differ in any other factor from the subjects who continued working. The logistic regression analysis resulted in a model with age (OR 0.77/ year, 95% CI: 0.71-0.88) and sick leave at T_0 (OR 0.27, 95%CI: 0.11-0.65) as determining factors for continuation of work (Hosmer&Lemeshow test: Chi^2 =9.2, p=0.33, indicating a good model fit).

As reason for not working the majority (79%) of the 61 subjects who stopped at follow-up mentioned being a housewife/-man, being a pensioner, doing voluntary work or combinations of these factors. Only 2 of them (3.6%) reported their hip/knee complaints and 3 (5.5%) mentioned other health complaints as reasons for not working. The proportions of subjects who had visited health care professionals at T_2 decreased compared to baseline, both in the group who continued working and in the group who stopped.

At follow-up 29 of the 428 working subjects (6.8%, compared to 7.7% at T_0) reported being on sick leave at the moment of filling the questionnaire, six of them because of hip/knee complaints (1.4%, versus 2.2% at T_0). 48 Subjects had been on sick-leave in the past 12 months because of their hip or knee complaints (11.2%, compared to 12.4% at T_0). Compared to baseline there was an increase in the proportion of working subjects who reported adaptations to their work [Table 3].

Negative experiences regarding work and career because of hip or knee complaints and because of other health complaints were mentioned by very small numbers of subjects. Difficulty finding work (1.4% for hip/knee complaints and 1.7% for other complaints, respectively), change of function (1%-6%), becoming unemployed (0.5%-1.9%), being refused a function (0.5%-1.0%) and being refused after an assessment (0.2%-0%) were reported. Only the other health complaints were reported by some as reason for being fired (1.9%), being refused promotion (1%) and being refused from insurance (2%).

			Subjects reporting adaptations	Total no. of adaptations	Type of work adaptation: Less hours	Other / less tasks	Work place / aids	Work Technique
Work adaptations have been made because of my hip/knee complaints	T_0	N	67	77	29	8	19	21
		(%)	(14)	(100)	(38)	(10)	(25)	(27)
	T_2	N	86	92	29	21	18	24
		(%)	(20)	(100)	(31)	(23)	(20)	(26)
I would like to have my work adapted because of my hip/ knee complaints	T_0	N	146	176	61	43	48	24
		(%)	(30)	(100)	(35)	(24)	(27)	(14)
	T_2	N	109	122	40	28	27	27
		(%)	(26)	(100)	(33)	(23)	(22)	(22)

Table 3:
Work adaptations made and desired by working subjects (n=493 at T_0, n=428 at T_2)

DISCUSSION

Participation in paid work in the CHECK cohort decreased from 51% to 46% in the 2 years since inclusion, which was not different from the general Dutch population, matched for age, sex and education level. Subjects who stopped working were 4.2 years older than those still in the labor force and they had reported a higher sick-leave at baseline. However, at follow-up only a few reported hip/knee problems or other health problems as reason for not working. Among the subjects who were working at T_2, sick leave because of hip/knee complaints or other health complaints was similar to baseline, but work adaptations increased. In all subjects the number of visits to health care professionals decreased.

A clear effect of OA on work participation may have been concealed by the fact that this participation rate is less than 50% anyway. In the Dutch generation of the CHECK cohort (45-65 year at baseline) many people older than 55 were financially facilitated by employers and by the state to retire early. However, there are differences per branch which make valid comparisons difficult. Furthermore, in the general population several other health conditions than OA may likewise have influenced work participation rates. A traditional family role-division in the generation under study, with men as breadwinners, also contributed to a relatively low work participation of women. These socio-economic factors may explain the low work participation in Dutch people older than 50 and all together mask the possible impact of OA. This may also explain why in the American literature frequently high indirect costs due to sickness impact are reported [1,4], since the participation rates of Americans in the older ages is significantly higher, and giving up work has a more severe effect on income. Because of demographic, labor market and economical developments the political trend in the Netherlands is to stimulate work participation (more working women, longer working life). This may lead to a more manifest effect of OA on work in the future. Many women in our study did not do paid work, but obviously their work in and around the house may be influenced. However, this was beyond the scope of our study.

Hip or knee problems apparently played only a minor role in the decision of 61 subjects to give up work, whereas age played the major role. On average the self-reported health status and more specifically the physical function of all subjects hardly changed from baseline, which may explain this observation. Physical demands in the work (at baseline) of both groups were not different either. The 61 subjects who stopped working had reported a high sick-leave rate (16%) at the moment of filling the questionnaire at baseline, but this was because of other health complaints than OA. This demonstrates that co morbidities may have affected the subjects' functioning and also that the sick-leave was probably not determined by a single factor. Although only a few subjects mentioned their health as reason for not working, this previous period of sick leave may have contributed to their decision to give up working. An alternative explanation is that their sick-leave coïncided with the recruitment period of CHECK; the actuality of their complaints may have stimulated them to participate. Amongst the subjects who continued working, the proportion reporting a period of sick-leave because of their hips or knees remained similar compared to baseline.

The impact of OA on work may increase with disease progress and duration [7]. In the end stage, successful return to work has been described in some patients after total joint arthroplasty [21]. Considering this, our data are the first on participation issues in the early disease stage [10]. An important strength of this study was that it concerned a large inception cohort on suspected early OA, including both working and non-working subjects. Confounding by over representation of older subjects with many co morbidities, for which studies on the impact of OA on work may be prone [22,23] was eliminated in our study design. Although not easy to interpret, our data seem to reveal early indicators of the impact of hip and knee complaints on physical function and work participation and of the measures that people try to take to cope with these circumstances. The observation that visits to health care professionals have decreased at T_2 may support the hypothesis that patients, after being told their diagnosis, indeed try to cope with their complaints [10].

20% Of the subjects reported having made changes in their work because of their hips or knees. This figure has increased compared to baseline and still some more subjects would like their work to be adapted. Changing one's work may be an action that precedes sick leave or that is taken in order to prevent this [7]. Worksite health interventions can support this preventive aim. They should include ergonomic work-place improvement, but also educational and counseling approaches aimed at improving coping style and behavior of workers with OA [24,25]. Remarkably the working subjects in our study, both at baseline and follow-up, reported a slightly better health and physical function than the subjects without paid work. Their better health may allow them to work, but may also be an effect of being active in a job.

Loss to follow-up is a threat in longitudinal cohorts, but was restricted in the CHECK study and, moreover, not selective for example for working participants. Unfortunately, in this study there was a relative lack of information on psychosocial work conditions and on the involvement of employers in work adaptations. This was due to the broad set-up of the cohort study, that was chosen to cover a wide range of topics. This kind of information would be relevant for a further exploration of the process of work continuation, sick-leave and work adaptations. Nevertheless, insight into these matters was gained and provides a solid base for follow-up studies in the cohort.

It appears that identifying those individuals who report the desire to adapt their work, and who may be vulnerable to the effect of OA on their working capacity, is a challenge for research and for rheumatologists and the occupational health field. In this way needless disability may be prevented. Monitoring the health and work ability of workers is applied by some employers and results of this seem promising [26,27]. Because of the earlier mentioned political aim to increase work participation and considering the stricter rules for the assessment of work disability claims, patients should be aware of the importance of maintaining their functional capacity. This requires efforts from patients themselves, their health care providers and their employers.

In conclusion, the 2-years course of work participation in early OA of hip and knee is similar to that in the general population, but the disorder starts to have an impact on the late stage of peoples' working life. Regarding the high prevalence of OA this impact may hamper the objectives of increasing the participation rate and of lengthening the working life period. Follow-up measurement in the cohort and longitudinal studies on younger generations (who are used or urged to the prospect of working longer and have different family role divisions) may clarify how the early signals of OA impact on work should be interpreted. Enabling people to stay at work, for example by facilitating work adaptations, is an important objective from both a general and an occupational health perspective.

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Chapter 5

Functional capacity evaluation in subjects with early osteoarthritis of hip and/or knee; is two-day testing needed?

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ABSTRACT

Introduction

The WorkWell Systems Functional Capacity Evaluation (WWS FCE) is a two-day performance based test consisting of several work-related activities. Three lifting and carrying test items may be performed on both days. The objective of this study was to assess the need for repeated testing of these items in subjects with early osteoarthritis of the hip and/or the knee and to analyze sources of variation between the two days of measurement.

Methods

A standardized WWS FCE protocol was applied, including repeated testing of lifting low, lifting overhead and carrying. Differences and associations between the two days were calculated using paired samples t-tests, Intraclass Correlation Coefficients (ICC) and limits of agreement (LoA). Possible sources of individual variation between the two days were indentified by Wilcoxon signed rank's tests. Pearson correlation coefficients were calculated for differences in performances between days and differences in possible sources of variation between days.

Results

79 Subjects participated in this study, their mean (SD) age was 56.6 (4.8) years, Median (min-max) WOMAC scores for pain, stiffness and physical function were 5 (0-17), 3 (0-7) and 14 (0-49), respectively. Median (min-max) SF36 physical function was 75 (5-95), and SF36 pain score was 67 (12-76). Mean performance differences ranged from -0.2 to -0.8 kg ($P > 0.05$). ICC's ranged from 0.75 (lifting overhead) to 0.88 (lifting low). LoA were: lifting low 8.0 kg; lifting overhead 6.5 kg; carrying 9.0 kg. Pearson's correlations were low and non-significant.

Conclusions

All three tests show acceptable two-day consistency. WWS FCE testing on two consecutive days is not necessary for groups of subjects with early osteoarthritis. Individual sources of variation could not be identified.

INTRODUCTION

Osteoarthritis (OA) is the most common form of arthritis and a cause of long term disability among adults. It is a slowly progressive, chronic, non-inflammatory disease primarily of weight-bearing joints [1]. Risk factors for OA include age, occupations causing repetitive joint trauma, continuous overuse of joints, obesity, physical activities/participation in sports, gender and genetic factors [1;2]. The American College of Rheumatology has developed classification criteria for OA of the knee and hip, which include clinical and radiographic aspects [3]. Clients with OA usually present with pain, morning stiffness, joint stiffness after periods of rest or inactivity, and joint crepitating [1]. OA is associated with absence from work, inability to work and poor quality of life [4;5;6].

The ability to perform daily activities is considered one of the most important outcome measures for patients with OA of the hip or knee [7]. To have a complete overview of patients' abilities is important for health related decisions, for example in referring to medical treatment and in return to work issues. Also for determining the outcome of clinical trials in OA a comprehensive measurement of (dis)abilities should be used.

Use of self-reported measures is generally preferred over performance based testing, because questionnaires are mostly well-validated, less expensive and less time consuming [7-9]. However, in several studies performance based tests have demonstrated to provide complementary information on degree of (dis)abilities. The authors of these studies recommend using both a performance based measure and a questionnaire to obtain a more comprehensive picture of the ability of the patient [10-12].

Performance based testing can be done by using Functional Capacity Evaluations (FCEs), which are performance based batteries of tests aimed at measuring functional abilities. One of the better known FCEs is the WorkWell Systems (WWS) FCE. The WWS FCE consists of 28 tests that measure activities such as lifting, carrying and bending [13;14]. Psychometric properties of this FCE have been investigated in patients with chronic low back pain (CLBP) and in healthy subjects. Support was found for aspects of validity [15-17].

In patients with CLBP and in healthy subjects acceptable reliability of the WWS FCE was found [18-20]. The original FCE demands testing on two consecutive days, with a total testing time of 4 to 5 hours. Three items - lifting low, lifting overhead and carrying – may be tested twice, once on each consecutive day [14]. However, it is not clear whether this two day testing is necessary in patients with OA. The WWS FCE will become much more efficient when testing time can be reduced and testing on one day would be sufficient.
To our knowledge, the need for repeated measurements of these three items has not been studied in OA before. Therefore the objectives of this study were to investigate stability of three FCE test items (lifting low, lifting overhead, carrying) in subjects with OA on two consecutive days, to analyze consistency of individual test results, and to analyze whether pain, hip and/or knee complaints and disease severity are possible sources of individual variation between both days.

METHODS

Subjects

Subjects participating in a large cohort study (Cohort Hip and Cohort Knee; CHECK [21]) were asked also to participate in this study. Inclusion criteria were: age between 45 and 65 years, pain and/or stiffness in hip and/or knee and never or not longer than 6 months ago visited the general practitioner for these symptoms for the first time. Subjects were excluded when they had any other pathological condition that could explain the existing complaints (e.g. other rheumatic disease, previous hip or knee joint replacement, congenital dysplasia, osteochondritis dissecans, intra-articular fractures, septic arthritis, Perthes' Disease, ligament or meniscus damage, plicasyndrome, Bakers cyste) or co-morbidity that did not allow physical evaluation and/or follow-up of at least 10 years, malignancy in the last 5 years, and inability to understand the Dutch language. Participant selection methods are described extensively by Wesseling et al. (2008) [21]. Written informed consent was obtained from all participants. The local ethics committee approved the study.

Procedures

After an introduction of the FCE procedures, subjects were briefly instructed on how to perform each test. The evaluator first showed each test once. In this way, a total of 12 tests were performed on day 1 and 13 tests on day 2. The tests of the WWS FCE protocol have been described elsewhere [19;20]. The first three tests of day 1 (lifting low, lifting overhead and carrying) were repeated on the second day. The first test consisted of lifting a weight from the floor to a table at waist height for 5 times with gradually (4-5 increments) increasing amounts of weight until maximum. With lifting overhead, the ability to lift a weight from waist height to crown height was assessed, in 5 times and with increasing the amount of weight in 4 to 5 steps. The carrying test consisted of two-handed carrying of boxed weights at waist height over 1.2 meters, 5 times with 4-5 weight increments. Each test was to be performed within 90 seconds [Table 1]. The subjects were asked to perform to their maximum abilities.

After each test subjects were asked to rate perceived exertion on a Borg CR10 scale [24]. Testing of lifting or carrying items could be terminated for three reasons (whichever came first):

1. Subjects were explained that they were allowed to stop the procedures at any point if they wished to do so, for example, because of insecurity or pain.
2. A heart rate monitor was worn by the subjects throughout the test procedures. A test was terminated when the subject's heart rate met or exceeded 85% of his or her age-related maximum.
3. The evaluator terminated testing if it became unsafe. Unsafety was defined as a situation in which the subject was not in full control of him- or herself and/or of the load.

After each test the evaluator recorded the results. Evaluator, time and place of assessment were held constant for the two consecutive FCE sessions. Each session lasted 2 to 3 hours. Before starting the FCE procedure subjects were asked to fill in three numerical rating scales (0-100 mm) on both days; one for pain in hip and/or knee at the moment, one for complaints of hip and/or knee at the moment, and one for disease activity at the moment.

Table 1:
Description of the WWS FCE Lifting low, Lifting overhead and Carrying test items performed on day 1 and day 2.

FCE activity	Description	Scoring
Lifting Low	5 lifts from table to floor v.v.; 4-5 weight increments; <90 sec.	Maximum amount of weight (kg)
Lifting Overhead	5 lifts from table to crown height v.v.; 4-5 weight increments; <90 sec.	Maximum amount of weight (kg)
Carrying short two handed	5 carries 1.2 meters; waist height; 4-5 weight increments; <90 sec.	Maximum amount of weight (kg)

Analyses

Data were analyzed using SPSS 13.0. Of the FCE protocol, only the three material handling tests performed on both days were analyzed in this study. Differences between tests on the two days on weight lifted and carried were analyzed using paired samples t-tests. One-way random Intraclass Correlation Coefficients (ICC) were calculated to analyze association between day 1 and day 2. An ICC of 0.75 or more was considered as acceptable reliability [23;24]. Stability of test results between the two consecutive days on group level was defined as: small and non statistically significant differences between the test scores on the two days, and ICC's of 0.75 or more. Bland and Altman analyses were performed to assess limits of agreement [25]. No criteria to interpret limits of agreement are available. Smaller limits of agreement indicate more stability because it indicates that the natural variation is small [25]. Individual performance differences between both days were expressed by calculating the % of subjects that scored better, worse or equal on day 2 compared to day 1. For the numerical rating scales Wilcoxon signed ranks tests were performed to analyze differences between the two days for these possible sources of variation in individual differences between the two days. Relationships between the day 1 – day 2 differences for self-reported pain, hip and/or knee complaints and disease severity and the differences in FCE test performances were expressed with Pearson's correlation coefficients to identify if these three variables were possible sources of individual variability over both days. Variables with high and statistically significant correlation coefficients were considered indicators for sources of variation. A significance level of 0.05 was used.

RESULTS

79 Subjects with early osteoarthritis of hip and/or knee were evaluated, of which 85% were female. Mean (SD) age of the patients was 56.6 (4.8) years, 13% of the subjects had complaints of hip, 22% complaints of knee and 65% of both hip and knee joints. At the start of the CHECK-study median (min-max) WOMAC scores for pain (range 0-20), stiffness (range 0-8) and physical function (range 0-68) were 5 (0-17), 3 (0-7) and 14 (0-49), respectively. Median (min-max) SF36 physical function was 75 (5-95), and SF36 pain score was 67 (12-76). These are comparable to the WOMAC and SF36 scores in the total CHECK cohort. In the CHECK cohort more than 65% of the participants scored Kellgren and Lawrence grade 0 for knee as well as for hip joint [21], indicating the early phase of disease in our population.

Table 2:
The amount of weight handled maximally on both days and differences between test and retest. Two-day reproducibility expressed in ICC (n = 79)

FCE activity	Day 1 mean kg (sd)	Day 2 mean kg (sd)	Difference mean kg (sd)	p *	ICC	LoA	LoA % mean Day 1
Lifting low	20.2 (8.9)	19.4 (8.5)	-0.8 (4.1)	0.10	0.88	8.0	40%
Lifting overhead	9.9 (4.9)	9.2 (4.2)	-0.6 (3.3)	0.10	0.75	6.5	66%
Carrying	20.4 (8.9)	20.3 (8.6)	-0.2 (4.6)	0.78	0.87	9.0	44%

*Paired samples t-tests; ICC = Intraclass Correlation Coefficient; LoA = Limits of Agreement

Mean (SD) scores of the two days for lifting low, lifting overhead and carrying on day 1 and day 2, differences between both days, ICC's and Limits of Agreement are presented in Table 2. Mean differences in test performance between the two days were statistically non-significant for all three activities ($P > 0.05$). ICC's were ≥ 0.75 for all three tests. Most tests were terminated because the subject did not want to proceed, only 5% of the tests were terminated when the subject was not in full control of him- or herself and / or of the load. No safety problems occurred during testing.

Bland & Altman figures are presented to analyze stability of the test results [Figure 1]. The 95% limits of agreement for lifting low are -8.8 and 7.2, for lifting overhead 95% limits are -7.1 and 5.9, and for carrying -9.2 and 8.8. There were no obvious relationships between the difference between both days and their mean test scores for all three tests.

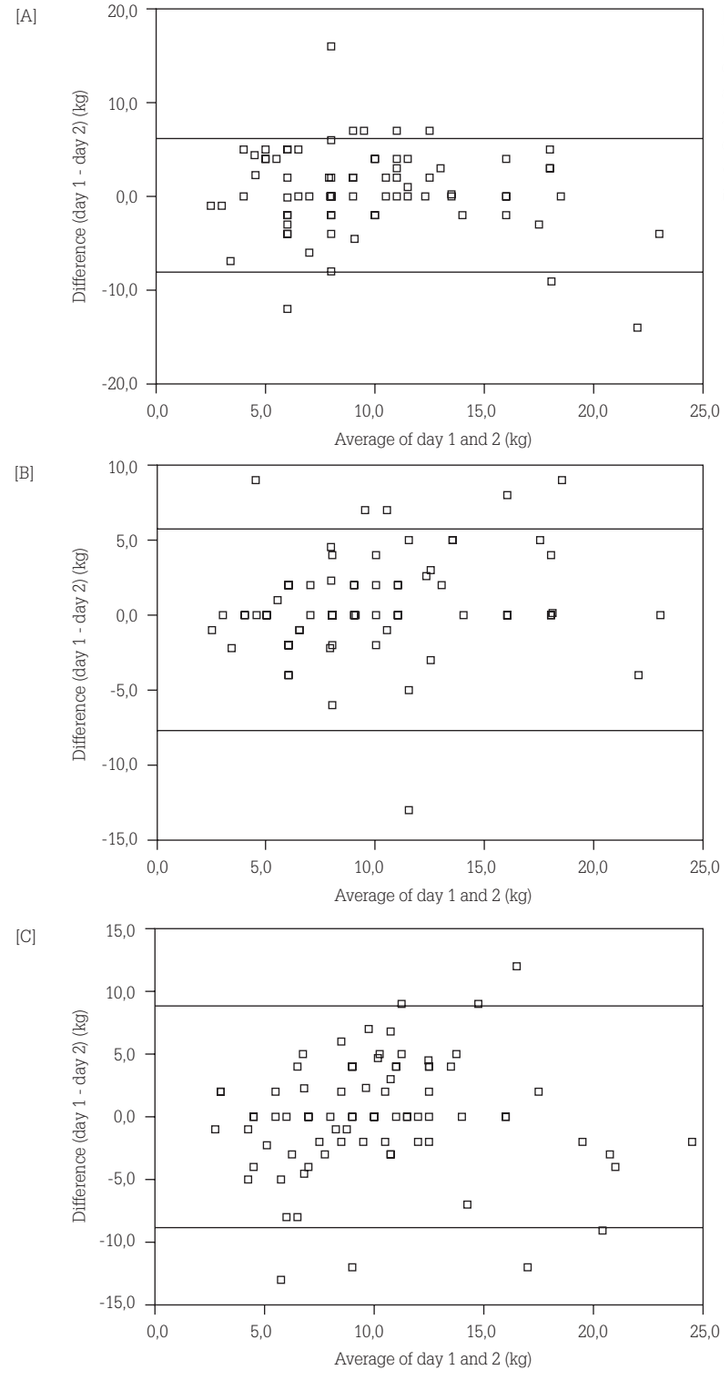

Figure 1:
Differences between the two days (day 1 – day 2) plotted against average ((day 1 + day 2)/2) for lifting low [A], lifting overhead [B] and carrying [C] with 95% limits of agreement indicated.

Table 3 shows the number of subjects that performed differently on the second day of testing, and reports the amount of the differences. Most individual subjects performed whithin a range of 20% less or more on day 2 compared to day 1, however a large proportion of subjects performed differently on day 2. Relatively large ranges in individual performance between both days were found.

FCE activity	Equal[1]		Worse[2]		Better[3]	
	n / %	Range (kg)	n / %	Range (kg)	n / %	Range (kg)
Lifting low	49 / 63 %	0 - 5	16 / 21 %	2 - 16	13 / 17 %	1 - 12
Lifting overhead	42 / 54 %	0 - 3	21 / 27 %	2 - 9	15 / 19 %	1 - 13
Carrying	46 / 59 %	0 - 2	17 / 22 %	2 - 12	15 / 19 %	2 - 13

[1] Amount of weight lifted / carried on day 2 < 20% less or more than amount of weight lifted / carried on day 1
[2] Amount of weight lifted / carried on day 2 ≥ 20% less than amount of weight lifted / carried on day 1
[3] Amount of weight lifted / carried on day 2 ≥ 20% more than amount of weight lifted / carried on day 1

Table 3:
Individual variation in FCE performance between both days

We hypothesized that the individual differences in FCE results between the two consecutive days could be influenced by pain, complaints and OA severity at the moment of the test. For this hypothesis to hold, we needed to find statistically significant differences on these variables between the two days, and high and statistically significant correlation coefficients between the two-day differences in these variables and the performance differences.

The self-reported pain, complaints of hip and/or knee and disease severity scores in our study population are presented in Table 4. Scores are not normally distributed, median scores on the second day are higher on all three measures, with large ranges. Differences between both days are statistically significant. On pain, 21% of subjects scored identical on both days, 14% reported less pain on the second day and 65% reported worse pain on the second day.
For complaints of hip and/or knee and for self-reported disease severity similar percentages were found (21, 19, 60 and 16, 17 and 67% respectively).

Reported health problem	Day 1 (median (min-max))	Day 2 (median (min-max))	Difference Day 1 - Day 2 ^
Pain	21 (0-67)	28 (0-86)	.000*
Complaints of hip and / or knee	24 (0-73)	27 (0-90)	.000 *
Disease severity	22 (0-74)	29 (0-91)	.000 *

^ based upon Wilcoxon signed ranks tests, *statistically significant difference

Table 4:
Results for self-reported pain, complaints of hip and / or knee and disease severity (0-100) just before FCE testing on both days

Pearson's correlation coefficients between differences in performances between days and the differences in reported health scores between both days are presented in Table 5. They were all low (< 0.25) and non-significant.

	Lifting low	Lifting overhead	Carrying
Pain	-.051	.115	-.083
Complaints of hip and / or knee	-.101	.067	-.077
Desease severity	-.004	.079	-.123

Table 5:
Pearson's correlation coefficients between differences in FCE performances and differences in self-reported pain, complaints and disease severity between both days

DISCUSSION

The results of this study show that two-day consistency of lifting low, lifting overhead and carrying is sufficient, because no relevant systematic differences between test performances on day 1 and day 2 were found and all ICC's were ≥ 0.75. As indicated by LoA, the natural variation is interpreted as large. The results of this study are similar to results of FCE studies in healthy subjects and in patients with nonspecific low back pain [18-20].

The WWS FCE is one of the few to conduct testing over two consecutive days. This two-day format is used to verify accuracy and to evaluate the effect of the first day assessment on the client [26]. Our results show that patients on average do not perform differently on lifting and carrying on the second day of testing. Repeated testing of these three items in patients with early OA therefore may not be necessary when testing groups of subjects. Based on our results the amount of time spent on group FCE testing can be reduced.

While this may be the case for groups of subjects, in daily practice FCEs are also performed to determine capacity of individual subjects. Based on the large limits of agreement and the individual differences in FCE scores between both days found in this study, some individuals may still need retesting. Testing on two days might be relevant when consistency of test results over two days is not expected. Results of this study indicate that differences in individual test performance between two consecutive days is unrelated to changes in self-reported pain, complaints and disease severity over both days. Sources of variation for the individual performance differences between both days could not be identified in this study. Probably other variables, for example motivation or fatigue, are of importance in individual FCE test stability in subjects with early osteoarthritis. More research is needed to identify which characteristics influence individual FCE test consistency in order to be able to modify the testing procedure or to select subjects that still need two-day testing when the FCE is used to assess physical function in individual subjects with early OA.

Former studies in FCE reliability were conducted in healthy subjects and in patients with chronic low back pain. Our sample consisted of subjects with only mild to moderate OA of hip and/or knee. Results from this study may not apply to subjects with more severe OA and to subjects with other health conditions.

Stability of test results over two days covers only one aspect of the psychometric properties of a measurement instrument. Test-retest reliability of the WWS FCE in subjects with OA should also be tested with a one to two week time interval between test sessions. The validity of the WWS FCE in OA should also be addressed in future research. Safety of the FCE in subjects with OA is another important aspect that should be further analyzed; although in our sample the majority of the subjects seemed to experience some pain and discomfort after testing, 2nd day performance was not significantly different from the first day, indicating that this pain increase was not related to injury or disability. During testing no safety problems occurred and no formal claims were made by the subjects.

FCE test selection is based upon the job factors of the Dictionary of Occupational Titles (DOT), a publication of the United States Department of Labor [27]. This dictionary describes the physical activities (job factors) that a job requires in a systematic way, by means of physical demands analysis. Whether the FCE is suitable for measuring one of the three, or all, main ICF health outcomes (impairment, activity limitation and participation restriction) remains unclear. The job factors described in the DOT and tested with the FCE may well be more physical demanding than activities as described in the ICF. Participation in work is an important aspect in OA because of the expected increase in prevalence of OA in working subjects and the substantial productivity related costs in OA [28,29]. Testing of job factors could prevent productivity loss by adjustment of working place and circumstances in subjects with OA.

In conclusion, this study indicated acceptable two-day consistency of three FCE test items in OA. The need for repeated testing of lifting low, lifting overhead and carrying on two consecutive days on group level could not be confirmed. Differences in individual test performance between both days were not related to changes in self-reported pain, complaints and disease severity over the two days.

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Chapter 6

Self-reported functional status as predictor of observed functional capacity in subjects with early osteoarthritis of the hip and knee. A diagnostic study in the CHECK cohort.

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ABSTRACT

Objectives

Patients with hip or knee osteoarthritis may experience functional limitations in work settings. In the Cohort Hip and Cohort Knee study (CHECK) physical function was both self-reported and measured performance-based, using Functional Capacity Evaluation (FCE). We studied relations between self-reported scores on SF-36 and WOMAC (function scales) and FCE performance, and assessed their diagnostic value for clinicians in predicting observed physical work limitations.

Methods

Ninety-two subjects scored physical function on SF-36 (scale 0-100, 100 indicating the best health level) and WOMAC (scale 0-68, 68 indicates maximum restriction) and performed the FCE. Correlations were calculated between all scores. Cross-tables were constructed using both questionnaires as diagnostic tests to identify work limitations. Subjects lifting <22.5 kg on the 'lifting-low' test were labelled as having physical work limitations. Diagnostic aspects were analysed at different cut-off scores for both questionnaires.

Results

Statistically significant correlations (Spearman's ρ 0.34-0.49) were found between questionnaire scores and lifting and carrying tests. Results of a diagnostic cross-table with cut-off point <60 on SF-36 'physical functioning' were: sensitivity 0.34, specificity 0.97 and positive predictive value (PV+) 0.95. Cut-off point ≥21 on WOMAC 'function' resulted in sensitivity 0.51, specificity 0.88 and PV+ 0.88.

Conclusion

Low self-reported function scores on SF-36 and WOMAC were seen to identify subjects with limitations on the FCE, however high scores could not exclude that subjects would demonstrate physical work limitations. These results are specific to the tested persons with early OA, in populations with a different prevalence of limitations, different diagnostic values will be found. FCE may be indicated to help clinicians to assess actual work capacity.

INTRODUCTION

Osteoarthritis (OA) of the hips and the knees is considered a major disabling disorder due to its restricting effect on mobility. While most prevalent in the elderly, recent publications demonstrated that younger people of working age may also be affected [1-3]. Disability at work depends on the functional capacity of the person and on the physical, mental and social demands of the job. There is little information on physical function in relation to physical job demands for people with OA. Most studies focus on activities of daily life (ADL) limitations in the more advanced stages of the disorder in elderly people. Functional status in hip and knee OA generally deteriorates slowly [4]. It is feasible that in the early stages a high physical load during work may result in pain and functional limitations of workers. These people may have little or no limitations in ADL that are less demanding than their work. Reports on work limitations in degenerative joint disease are scarce [5].

Limitations in ADL are often measured with validated self-report instruments such as the 36-item Short-form Health Status Survey (SF-36 [6], generic) or Western Ontario and McMasters University Osteoarthritis Index Index (WOMAC [7], arthritis specific). These instruments focus on perceived limitations, whereas performance based tests of functional capacity focus on observed test behaviour. Functional Capacity Evaluations (FCE) are applied in specific contexts as pre-job screening, work rehabilitation and assessment of disability claims [8;9]. The tests are physically demanding and take several hours to complete the full protocol. The validity of self-report and performance-based instruments is still under debate [10-12]. Terwee et al. [13] concluded that information on measurement properties of many performance-based methods for people with OA is incomplete, which makes it difficult to select an appropriate method. The psychometric properties of FCE have been described for healthy subjects and subjects with low back pain [14-16]. Reneman et al. [17] studied the concurrent validity of an FCE and self-reports on disability in relation to chronic low back pain. They found poor to moderate correlations between FCE results and outcomes of the low back related self-reported disability.

The Cohort Hip and Cohort Knee (CHECK study [18]) aims to study the course of early OA of the hip and the knee in people between 45 and 65 years (at inclusion). The course of impairments, disabilities and problems with social participation due to hip and knee complaints will be described. To cover a spectrum of biopsychosocial variables, a set of generic methods and instruments is used. We examined the potential use of two of these methods (self-report questionnaires) for predicting functional limitations on an FCE-battery. FCE's have been criticized because of the burden of testing, both for patients and clinicians. A good solution would be to develop a clinical rule to indicate if and when an FCE is needed to assess functional capacity for work. This rule would be helpful for general practitioners, rheumatologists, occupational physicians and physical therapists. Therefore, the objectives of this study were:

1. To describe the relation between on one hand the scores on SF-36 'physical function' and WOMAC 'function' and on the other hand performance on a Functional Capacity Evaluation.
2. To determine the optimal cut-off point for the use of self-reports as diagnostic test to identify work limitations.
3. To study the diagnostic properties and diagnostic values of SF-36 and WOMAC in predicting limited functional capacity on the FCE.

METHODS

Design

This study is a cross-sectional study in a sample of subjects participating in the CHECK cohort, a multi-centre longitudinal study on early OA (n=1002) [18]. After inclusion in the cohort all subjects received a comprehensive questionnaire, composed from several validated questionnaires. All subjects from the CHECK-centres Groningen and Enschede (n= 153) were additionally invited to participate in this study in which the ability to perform work related activities was assessed with a Functional Capacity Evaluation.

Subjects

Inclusion criteria for the CHECK cohort were hip and/or knee complaints for which the subject visited the general practitioner no longer than 6 month ago and that were not attributed to direct trauma or other disorders. The age of the subjects was between 45 and 65 year. Exclusion criteria were the presence of inflammatory rheumatic disorders, joint prosthesis (hip and knee), previous joint trauma and serious co morbidity. All participants provided written informed consent before entering the study, and the Medical Ethical Board of hospital 'Medisch Spectrum Twente' in Enschede, The Netherlands, approved the study.

Measurements

Performance based outcome measures: the WorkWell Systems Functional Capacity Evaluation (WWS FCE [19]) was used to assess subjects' work capacity. 22 Tests, including all those that cause load bearing to the hips and the knees, were selected from the standardized 2-day WWS FCE protocol. These tests aim to record maximal capacity with regards to strength, endurance or speed. Providing the test leader judged the tests to be performed safely, subjects were asked to continue to a higher load level (5 repetitions per level). The static endurance tests were continued until a preset limit was reached. The subject was free to end any test at any moment for example because of discomfort or pain. Preceding the FCE tests subjects' age and sex were registered and the following measurements were performed: length, weight, Body Mass Index (BMI), location of the complaint (hip/knee/both and left/right/both).

Self-report outcome measures: the SF-36 and the WOMAC (Dutch versions) were used. The SF-36 [6] is a validated 36-item questionnaire that measures 8 domains of health; in this study the scale for 'physical functioning' was used (containing 10 items with a 3 point Likert Scale, leading to a transformed score range of 0-100 in 20 steps of 5 points, 100 indicating the highest level of functioning). The WOMAC [7] is a validated self-administered questionnaire for patients with hip or knee OA, consisting of 24 questions categorized in subscales of pain, stiffness and function. In this study the 'function' scale was included in the analyses (17 items, 5 point Likert Scale, score range 0-68 in 68 steps, 68 indicating maximal restrictions in function).

Diagnostic cross-table: analogous to diagnostic tests for diseases, 2x2 cross-tables were constructed for disease presence (yes/no) and diagnostic test result (positive/negative). In our cross-tables the presence of observed work limitations in the FCE was related to scores on the self-report questionnaires. To split the subjects in a group with work limitations and a group without work limitations, criteria from the Dictionary of Occupational Titles (DOT [20]) were used. The DOT categorises physical job demands into 5 categories, which are mainly based on the amount of weight to be lifted in the job. Subjects only able to perform work tasks which lay within the lowest physical levels of activity, classified as sedentary or light tasks (lifting occasionally up to 22.5 kg, based on the FCE test 'lifting low') were labelled as having 'work limitations'. Those who were able to perform medium, heavy or very heavy work (lifting occasionally 22.5 kg and more) were considered to have 'no work limitations'. Questionnaire results reflecting self-reported restrictions in physical function (scores below a chosen cut-off value for SF-36 and scores over a WOMAC cut-off point) indicated a positive test result, the remaining scores indicated a negative result.
In summary, a cross-table was constructed to evaluate the potential diagnostic value of the physical function subscales of SF-36 and WOMAC (self-reports) in predicting functional work limitations on the FCE (performance test).

Protocol

Questionnaires were filled in on inclusion into the cohort. FCE was performed after subjects gave informed consent to participate in this spin-off study (additional to the cohort). As a result there was a time lapse between the self-reporting and the FCE. Tests were led by 4th year Physical Therapy students who received a one-day training in the procedure and the execution of the tests. They were supervised by the research team. Testers were blinded for the self-report outcomes and the criteria for interpretation (22.5 kg).

Statistical analysis

Descriptive statistics were performed on the results from FCE, SF-36 'physical function' and WOMAC 'function'. Correlations between FCE performance and questionnaire scores were assessed using Spearman rank correlation coefficients. Bonferroni procedures [21] were applied to reduce type I error, adjustment for 44 comparisons at $\alpha = 0.05$ resulted in the use of $P < 0.001$ as level of significance.

Frequency tables of 'lifting low' performance for different SF-36 scores and WOMAC scores were used to construct cross tables for a series of cut-off points. Diagnostic properties and diagnostic values of the tests (see the text box for an introduction) were calculated for each cut-off point.

> A brief introduction to diagnostic properties and values:
> Sensitivity (Se) is the probability of a positive test outcome given that the disorder (in this study: work limitations) is present, specificity (Sp) is the probability of a negative test outcome given that work limitations are not present. Of practical importance for clinicians are the positive predictive value (PV+), this is the probability that an individual has work limitations in case of a positive test outcome, and the negative predictive value (PV-), this is the probability that an individual does not have work limitations in case of a negative test outcome. However, both PV+ and PV- are affected by the prevalence of the disorder in the studied population.

Statistical as well as clinical criteria were used to determine the optimal cut-off point for SF-36 and WOMAC scores that indicated a positive test. Results for the chosen cut-off points were displayed in scatter plots with scores on questionnaire versus FCE performance on 'lifting low'. To match the plots with the quadrants of the diagnostic

cross tables the SF-36 scores on the y-axis were inverted: 0 was put on top of the y-axis, because low scores indicate a positive diagnostic test outcome.

Since only the 'lifting low' test was used to determine the cut-off points of the self-reports, we subsequently examined whether applying these cut-off scores to the other FCE tests would also clearly divide the subjects in low and high performers. This was done by testing the differences in performances on all the other FCE tests between persons with a positive test and those with a negative test. Independent samples T-tests were used on the manual material handling tests; Mann Whitney tests were used on the other tests, because of ceiling and criterion effects. The threshold of significance (α) was chosen at 0.05.

RESULTS

Subjects

Ninety-two CHECK-participants (79 women, 13 men) were enrolled in this study. Of this sample, 59 had complaints of the hip(s) as well as the knee(s). Subject's characteristics are described in Table 1. They were very similar to the other 849 subjects in the cohort and to the 61 non-participants, with regards to age, sex, body mass index, work participation and scores on physical function scales of SF-36 and WOMAC.

Variable	FCE-participants (n = 92)		Non FCE-participants (n = 61)		Others in cohort (n = 849)	
	Mean (SD)	Median (range)	Mean (SD)	Median (range)	Mean (SD)	Median (range)
Age (years)	56 (4.9)	56 (47–65)	55 (5.8)	55 (45–65)	56 (5.2)	56 (45–65)
Female sex (%)	84		87		78	
Work participation (%)	48		50		46	
BMI (kg/m^2)	26.0 (4.5)	25.1 (13-40)	26.2 (3.7)	25.3 (21–40)	26.2 (4.1)	25.5 (15–49)
SF-36 physical functioning[a]	71.2 (21.6)	75 (5–100)	74.3 (16.5)	75 (25–100)	75.1 (16.7)	80.0 (5–100)
WOMAC function[b]	18.1 (12.1)	15.0 (0–49)	16.5 (11.7)	16.0 (0–53)	15.7 (11.6)	13.0 (0–56)

[a] On a scale of 0 (worst situation) to 100 (best situation)
[b] On a scale of 0 (best situation) to 68 (worst situation)

Table 1:
Subject characteristics of FCE-participants, non-participants and the rest of the cohort.

Study objective 1: correlations

Spearman's rho (ρ) for correlations between the scores on SF-36, WOMAC and FCE are presented in Table 2. WOMAC correlations were negative where SF-36 correlations were positive because at the WOMAC higher scores indicate more restrictions. The highest correlation was found between the two self-report instruments. Correlations between self-reports and nearly all manual material handling FCE tests were statistically significant with ρ-values ranging from 0.34 tot 0.49. Correlations with most of the other FCE-tests were not statistically significant. Results for the stair climbing test (10 x 10 stairs) were not presented because 34 subjects reached the preset heart rate safety limit (85% of maximal heart rate) and had to end the test prematurely.

Table 2:
Spearman rank correlation coefficients for SF-36, WOMAC and FCE tests

* P < 0.001

Study objective 2 and 3: cut-off points and diagnostic values. In Table 3 the diagnostic qualities at different cut-off points are presented of both SF-36 'physical function' and WOMAC 'function', in relation to work limitations (the defined 'disease').

	SF-36 *(physical function)*	WOMAC *(function)*
WOMAC function	.70*	
Manual material handling (kg)		
Lifting low	.37*	-.37*
Lifting high	.32	-.39*
Carry short	.36*	-.39*
Carry long, two hands	.34*	-.43*
Carry long, R hand	.46*	-.47*
Carry long, L hand	.38*	-.49*
Push static	.20	-.34
Pull static	.31	-.37*
Static posture, endurance (s)		
Static overhead work	.13	-.32
Static bent work	.26	-.29
Kneeling	.33	-.45*
Squat	.23	-.18
Dynamic movements, speed (s)		
Crawling	-.21	.24
Dynamic bent work	-.20	.30
Repetitive squats	-.27	.36*
Stand L repetitive rotation	-.13	.19
Stand R repetitive rotation	-.12	.18
Sit L repetitive rotation	-.04	.12
Sit R repetitive rotation	-.11	.18
Ladder	-.33	.30
Dynamic movements, endurance (m)		
Shuttle walk	.25	-.39*

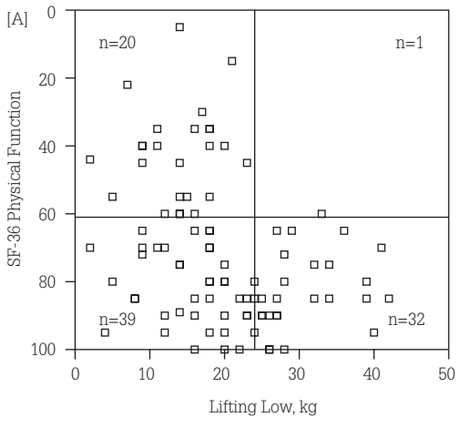
The table illustrates that, as in every diagnostic test, shifting the cut-off point resulted in a trade-off between sensitivity and specificity. For SF-36 a cut-off point of <60 points was chosen, because at this score the highest specificity (0.97) is reached in combination with a high likelihood ratio for a positive test (11.1); 21 subjects (23%) are tested 'positive'. For WOMAC a cut-off point of ≥21 was chosen, which gave lower specificity and higher sensitivity compared to SF-36. This cut-off point resulted in 34 subjects (37%) with a positive test.

Self-report instrument	Cut-off point	Positive and negative tests (+/-)	Sensitivity	Specificity	Likelihood ratio of positive test
SF-36 physical function	55	17/75	0.27	0.97	8.9
	60	21/71	0.34	0.97	11.1
	65	26/66	0.41	0.94	6.7
	70	33/59	0.47	0.85	3.1
	75	42/50	0.59	0.79	2.8
	80	47/45	0.64	0.73	2.4
	85	55/37	0.73	0.64	2.0
	90	68/24	0.81	0.39	1.3
WOMAC function	25	28/64	0.41	0.88	3.4
	24	30/62	0.44	0.88	3.6
	23	31/61	0.46	0.88	3.8
	22	32/60	0.47	0.88	3.9
	21	34/58	0.51	0.88	4.2
	20	38/54	0.54	0.82	3.0
	19	39/53	0.56	0.82	3.1
	18	40/52	0.56	0.79	2.6
	17	43/49	0.59	0.76	2.4
	16	45/47	0.61	0.73	2.2

Table 3:
Properties of SF-36 'Physical function' and WOMAC 'Function' as a diagnostic test for work limitations, at different cut-off points.

In Figure 1 scatter plots of the results of all subjects are presented in combination with cross-tables with the diagnostic values at the chosen cut-off points. The self-report scores predicted low performance on the FCE-test 'lifting low' for 20 out of 21 positive tests on the SF-36 (Positive Predictive Value, PV+ = 0.95) and for 30 out of 34 positive tests on the WOMAC (PV+ = 0.88). The PV- for SF-36 and WOMAC were 0.45 and 0.50, respectively.

In Table 4 the performances on all the FCE tests are compared for subjects with positive and negative diagnostic tests. These results indicate that on manual material handling tests persons with negative tests (high self-reported function) handled heavier weights. All differences in test results were statistically significant.



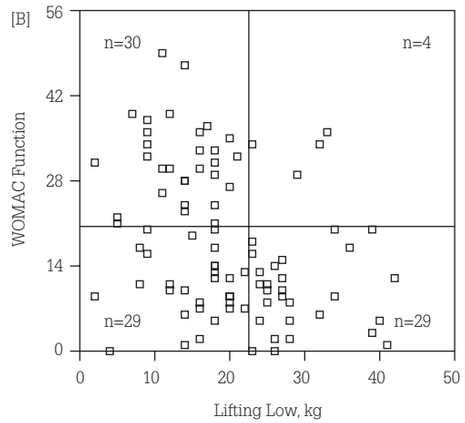


Figure 1:
[A] Scatter plot for lifting performance versus SF-36 'physical function' with cut-off scores indicated; to match the plots with the quadrants of the diagnostic cross tables, the SF-36 scores on the y-axis were inverted (0 on top of the y-axis); corresponding cross table + diagnostic values.

[B] Scatter plot for lifting performance versus WOMAC 'function' with cut-off scores indicated; corresponding cross table + diagnostic values.

SF-36: Physical Function, cut-off point <60		Work Limitations <22.5 kg +	≥22.5 kg -	
	<60: +	20	1	21
	≥60: -	39	32	71
		59	33	92
Prevalence = 59/92 = 0.64				
Sensitivity = 20/59 = 0.33 (95%CI: 023-0.43)				
Specificity = 32/33 = 0.97 (95%CI: 0.94-1.0)				
Predictive Value + = 20/21 = 0.95 (95%CI: 0.91-0.99)				
Predictive Value - = 32/71 = 0.45 (95%CI: 0.35-0.55)				
Likelihood Ratio + = 11.2 (95%CI: 5.9-21.3)				
Likelihood Ratio - = 0.68 (95%CI: 0.49-0.94)				

WOMAC: Function, cut-off point ≥21		Work Limitations <22.5 kg +	≥22.5 kg -	
	<21: +	30	4	34
	≥21: -	29	29	58
		59	33	92
Prevalence = 59/92 = 0.64				
Sensitivity = 30/59 = 0.51 (95%CI: 0.41-0.61)				
Specificity = 29/33 = 0.88 (95%CI: 0.81-0.95)				
Predictive Value + = 30/34 = 0.88 (95%CI: 0.81-0.95)				
Predictive Value - = 29/58 = 0.50 (95%CI: 0.40-0.60)				
Likelihood Ratio + = 4.2 (95%CI: 2.32-7.60)				
Likelihood Ratio - = 0.6 (95%CI: 0.33-1.09)				

	Mean SF+ n = 21	Mean SF- n= 71	Mean diff.	P	Mean WOMAC+ n = 34	Mean WOMAC- n = 58	Mean Diff.	P
Manual material handling (kg)								
Lifting low	13.8	21.5	7.7	.001	15.2	22.4	7.2	.000
Lifting high	5.8	10.7	4.8	.000	6.8	11.2	4.4	.000
Carry short	13.2	21.9	8.7	.000	14.6	23.0	8.4	.000
Carry 2 hand	16.2	24.4	8.1	.002	17.2	25.6	8.4	.000
Carry right	16.4	23.4	7.0	.001	16.4	25.0	8.6	.000
Carry left	15.4	23.1	7.7	.001	15.8	24.6	8.8	.000
Push static	21.0	28.5	7.5	.010	21.5	30.1	8.5	.000
Pull static	24.0	35.9	11.9	.003	26.4	37.4	11.0	.000
	Median SF+	Median SF-		P	Median WOMAC+	Median WOMAC-		P
Static posture, endurance (s)								
Static overhead	145	166		.353	144	174		.006
Static bent	191	339		.006	231	378		.005
Kneeling	146	300		.001	236	300		.001
Squat	60	60		.017	60	60		.099
Dynamic movements, speed (s)								
Crawling	51	48		.083	54	43		.011
Bent dynamic	60	54		.114	61	53		.018
Repeated squat	53	49		.102	53	48		.007
Stand L repetitive rotation	89	81		.024	86	83		.068
Stand R repetitive rotation	86	79		.105	84	79		.105
Sit L repetitive rotation	90	84		.247	88	84		.350
Sit R repetitive rotation	91	85		.249	91	85		.064
Ladder	143	113		.013	136	111		.009
Dynamic movements, endurance (m)								
Shuttle walk	250	330		.011	250	330		.000

Table 4:
Comparison of mean or median results on the FCE tests for groups SF+ and SF- and for WOMAC+ and WOMAC-, tested with independent t-tests (Manual Material Handling) or Mann-Whitney tests (others)

For static posture tests the results were mixed. Although not all of them were statistically significant the tendency was for both SF-36 and WOMAC that subjects with negative tests demonstrated higher endurance. Most of the dynamic tests did not show significantly different results, although the group with negative tests performed faster on average. On the shuttle walk test persons with negative diagnostic tests walked longer distances. In summary the group with good self-reported function performed better on all FCE tests.

DISCUSSION

The main objectives of our study on persons with early OA of the hip and the knee were to describe relations between scores on the function scales of SF-36 and WOMAC and performance on the FCE and to determine the diagnostic value of these scales in predicting limited capacity on the FCE. If these questionnaires demonstrate predictive value in identifying physical work limitations, they can help clinicians to decide whether or not an FCE is indicated to evaluate physical work capacity.

The invitation to voluntarily participate in this study could have introduced selection bias, if for example people with a higher physical capacity were more willing to perform the demanding tests. Our results however indicated that the subjects were similar to the non-participants on the variables compared. Neither were there any differences in comparison to the rest of the cohort with respect to age, sex, work participation, body mass index and SF-36 and WOMAC scores. These scores indicated that our subjects, included as having early OA, were in relatively good self-reported health.

The correlations between the scores on questionnaires and the performance on the FCE varied in a logical manner, that provides construct validity to subtests of the FCE. A number of questionnaire items correspond almost literally with FCE items (for example lifting or carrying groceries, kneeing/stooping, walking), but other items refer to activities that are not in the FCE protocol (for example bathing or dressing). Furthermore, the relation between self-reported functional status and observed performance must have been influenced by other than physical factors. Both physical and psychological factors have been identified as having influence on the functional status with regard to mobility of older people with OA [22-25]. FCE tests that require strength showed the highest correlations with the self-reports. An explanation may be that these tests put the highest mechanical loads on the hips and knees, resulting from the combination of body movements and the weights lifted or carried. Self-reported disability because of pain or discomfort was expressed clearly on these tests. In the other tests speed or endurance were more called on than strength and factors such as dexterity or willingness to continue may have become decisive.

Similar to diagnostic tests for diseases we constructed a diagnostic cross-table. The aim of this action was to explore whether those subjects who showed work limitations on the (physically demanding) FCE could be identified based on their (easily obtained) self-reported functional score. Although we performed a cross-sectional study we used the term 'prediction' to indicate whether questionnaire scores gained useful information about subsequently observed performance. Our choice of the FCE test 'lifting low' as criterion for work limitations was based on the DOT-system in which lifting of weights is regarded as a critical job demand. The table of 22.5 kg corresponds with the limit between light and medium physical demands (DOT) and also equals the recommended weight limit of the NIOSH guideline [26] that claims to be safe for 99% of men and 75% of women in an ideal lifting situation. We considered the DOT and the NIOSH guidelines as widely accepted and best available evidence for choosing a criterion. Applying this 22.5 kg limit, the prevalence of work limitations in our subjects was 64%. Since 85% of our subjects were women with a mean age of 56 and less than 50% of them were in paid work, this result seems plausible.

In our cross-table we have chosen a cut-off point of <60 points on the SF-36 subscale physical function as criterion for a positive diagnostic test. This choice was based on a combination of parameters, i.e. the likelihood ratio for a positive test (LR+), the high predictive value of a positive test, the high specificity and a useful number of positive tests.

The diagnostic cross-table enabled us to predict low performance on the FCE-test 'lifting low' based on poor self-reported physical function for 21 of our 92 subjects, with 95% 'true positive' outcomes. The LR+ of 11.2 indicated that this positive test outcome increased the odds of subjects demonstrating work limitations on the FCE from the base rate of 59/33 to 20/1. The osteoarthritis specific WOMAC was cut-off at a score of ≥21 points (on the 0-68 'function' scale). The use of this cut-off point identified 34 subjects with a positive test (poor self-reported function) and resulted in 88% 'true positive' outcomes. Compared to SF-36 the WOMAC identified 13 more subjects with work limitations at the cost of a 7% decrease in certainty of this positive diagnosis. Apparently the strenght of

both questionnaires lies in its positive predictive value to identify subjects with work limitations in the early stage of the OA.

The use of the FCE-test 'lifting low' as criterion for work limitations was supported by the outcomes of applying the same diagnostic criterion (a SF-36 'physical functioning' score <60 or WOMAC 'function' ≥21) to the other 'manual material handling' tests of the FCE. Although we did not present them, the resulting scatter plots and cross tables were very similar. We concluded that these scores indeed predict physical work limitations, especially where lifting and carrying were critical job demands. These are the same FCE tests that showed significant correlations with self-report scores [Table 2].

The negative predictive value of the questionnaire scores in our diagnostic cross-table was low, due to the many subjects with good self-reported functional status who nevertheless demonstrated low FCE-scores. The questionnaires capture limitations in a range of activities of daily life (ADL) but do not refer sufficiently to specific work related activities. The strength of SF-36 and WOMAC lies therefore not in selecting people that are capable to perform heavier work; for that aim additionally the FCE can be used. In populations with a different prevalence of work limitations, the PV+ and PV- will be different; for example in a population of healthy workers with a lower prevalence of work limitations, a lower PV+ and a higher PV- are expected.

A limitation of this study was that due to the inclusion procedure an average time lapse of 5 months arose between answering of the questionnaires and participation in the FCE. We assumed both measurements to be relatively stable at the start of our cohort. Van Dijk et al. [4] concluded in her review that functional status in hip and knee OA deteriorates slowly in the first three years. FCE measurements do show a high test-retest reliability but also some natural variation [15;16] within the individual. The FCE data of the first follow-up measurement (T_1, one year later) however do not indicate performance changes compared to the baseline measurement.

Our diagnostic cross-table demonstrated that poor scores on self-reported functional status were related to low performance on a Functional Capacity Evaluation in early osteoarthritis of the hip and the knee. We agree with Vignon et al. [27] that in general health care practice awareness must be stimulated for the relation between hip and knee complaints of younger people and their work capacity. Patients with physically demanding work should be advised to visit the occupational physician and/or the Human Resources Management staff of their employer to discuss the opportunities for work adaptations. In the setting of occupational health care the use of an FCE in addition to self-reports is advised for a more specific assessment of work capacity. Also more occupation specific questionnaires or surveys should be selected or developed and translated in different languages. These should also cover mental and social work aspects. Follow-up studies on work limitations in OA will be done in the CHECK cohort.

In conclusion, in subjects with early OA low self-reported physical function scores on SF-36 and WOMAC both demonstrated good diagnostic value as tests for limitations on the FCE. However, the diagnostic values are disorder specific and therefore in populations with a different prevalence of limitations, different diagnostic values will be found. Depending on the level of accuracy needed, self-report may be sufficient to assess physical function. Better self-report scores could not exclude that subjects demonstrated work limitations. Therefore an FCE may be indicated to help clinicians to assess actual work capacity.

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Chapter 7

Functional capacity of people with early osteoarthritis: a comparison between subjects from the Cohort Hip and Cohort Knee (CHECK) and healthy ageing workers.

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ABSTRACT

Objective

The prevalence of osteoarthritis (OA) increases, but the impact of the disorder on peoples' functional capacity is not known. Therefore the objective of this study was to compare self-reported health status and functional capacity of subjects with early OA of hip and/or knee to reference data of healthy working subjects and to assess whether this capacity is sufficient to meet physical job demands.

Methods

Self-reported health status and functional capacity of 93 subjects from the Cohort Hip and Cohort Knee (CHECK) were measured using the ShortForm-36 Health Survey and 6 tests of the WorkWellSystems Functional Capacity Evaluation. Results were compared with reference data from 275 healthy workers, using t-tests. To compare the functional capacity with job demands, the proportions of subjects with OA who were performing lower than the p_5 of reference data were calculated.

Results

Compared to healthy workers the subjects (mean age 56) from CHECK at baseline reported a significantly worse physical health status, whereas the females (n=78) also reported a worse mental health status. On the FCE female OA subjects performed significantly lower than their healthy working counterparts on all 6 tests. Male OA subjects performed lower than male workers on 3 tests. A substantial proportion of females demonstrated functional capacities that could be considered insufficient to perform jobs with low physical demands.

Conclusions

Functional capacity and self-reported health of subjects with early OA of the hips and knees were worse compared to healthy ageing workers. A substantial proportion of female subjects did not meet physical job demands.

INTRODUCTION

An increase in the participation in paid work of people in the age of 45-65 is considered necessary to afford the costs that are generated by the ageing of the population [1-3]. However, current knowledge about the health status and the functional capacity (the ability to perform work-related activities) of this worker category [4-6] raises the question whether this pursuit is realistic. Older workers with chronic diseases or disorders are specifically at risk of developing work disabilities and loosing their job [4;7]. Regarding rheumatic diseases ample evidence indicates that rheumatoid arthritis (RA) has a negative impact on the work participation of patients [8;9]. For osteoarthritis (OA) however, there is limited information with regard to work participation [1;10] and functional capacity for work related activities [11]. This disorder is of particular interest because of its increasing prevalence, related to the ageing of populations and the rising prevalence of overweight and obesity [12]. Since people with OA often experience limitations in physical functioning, an effect on work participation may be anticipated. There is a lack of knowledge about the work status and functional capacity of people with early OA compared to healthy people. As a consequence, the need for (preventive) interventions to maintain functional capacity and to stimulate work participation remains unclear.

Several work-related and individual factors are related to work ability [5]. One of the individual factors is the functional capacity, which can be assessed with a Functional Capacity Evaluation (FCE). An FCE is an evaluation of the capacity to perform activities that is used to make recommendations for participation in work, while considering the person's body functions and structures, environmental factors, personal factors and health status [13]. FCE's are used in many countries worldwide in rehabilitation, occupational health care and insurance settings. Performance based data provides clinicians with additional information about functioning that would be missed when relied on self-reports only [14].

The aims of this paper were to assess the self-reported health status and the observed functional capacity of people with early OA in hips and/or knees and to compare these to a reference sample of healthy workers, matched for age and controlled for sex. It was assumed that the functional capacity of healthy workers was sufficient to meet the physical demands in their jobs. This comparison, therefore, enabled assessment of the functional capacity of subjects with OA in relation to physical job demands.

Research questions were:

1. Is the self-reported health status of subjects with early OA different from healthy workers?
2. Is the observed functional capacity of subjects with early OA different from healthy workers?
3. Is the functional capacity of subjects with early OA sufficient to meet physical job demands?

METHODS

Design

Self-reported health status and functional capacity of a subsample from the Cohort Hip and Cohort Knee (CHECK) study on early osteoarthritis [15] were measured at baseline of this 10-year cohort study. Results on both measures were compared to reference data from a separate study that was performed in 702 healthy workers, with the aim to establish normative data [13].

Subjects

Inclusion criteria for the CHECK cohort were hip and/or knee complaints for which the subject visited the general practitioner no longer than 6 months ago and that were not attributed to direct trauma or other disorders. The age of the subjects at baseline was between 45 and 65 years. Exclusion criteria were the presence of inflammatory rheumatic disorders, joint prosthesis (hip and knee), previous joint trauma and serious co morbidity. Wesseling et al. [15] concluded that subject characteristics (n=1002) at inclusion indeed label CHECK as an early OA cohort. Based on the classification by the Kellgren & Lawrence [16] rating score the proportion of subjects with radiological osteoarthritis (K&L>1) was 7% for the knee and 6% for the hip. However, 76% of the patients with knee symptoms could be diagnosed as OA according to the clinical ACR criteria for classification of knee OA [17]. Only a minority of CHECK participants with hip symptoms (24%) fulfilled the clinical classification criteria of hip OA [18]. All participants provided written informed consent before entering the study, and the Medical Ethical Board of hospital 'Medisch Spectrum Twente' in Enschede, the Netherlands, approved the study.

In the healthy worker study [13] subjects between 20 and 61 years were included that were working in a wide range of professions and who reported no absenteeism due to musculoskeletal complaints in the year before the assessment. For this comparative study, the data from all subjects aged 45-61 were used (183 males and 92 females).

Measurements

Self-reported health status

All subjects filled out the Short-Form 36 Health Survey (SF-36, [19]). The SF-36 consists of 36 items that cover 8 aspects of health. The physical function, physical role, bodily pain and general health subscales together comprise the 'physical component' of the person's health status. The social function, emotional role, mental health and vitality subscales comprise the 'mental component' of a person's health status. All raw scores were transformed into scores in a range between 0 and 100 and a higher score on the subscales and components represented a better health status.

Functional Capacity

The WorkWell Systems Functional Capacity Evaluation [20] was used to assess subjects' capacity to perform work related activities. Twenty-two tests, including all those that cause load bearing to the hips and the knees, were selected from the standardized 2-day WWS FCE protocol. These tests aim to record capacity with regards to manual material handling, working postures and movements, and refer to physical strength, endurance or speed. Providing the evaluator judged the tests to be performed safely, based on observation criteria as movement pattern and postural changes [20;21] subjects were asked to continue to a higher load level (5 repetitions per level). The static endurance tests were continued until a preset limit (15 minutes) was reached. The subject was free to end any test at any moment, for example because of discomfort or pain. Comparisons with the healthy workers were made on 6 standardized tests that represent physical job demands and that were performed in both populations. These tests, the reliability of which has been established [22-25] are listed on page 143.

Material Handling

Lifting Low

Objective: capacity of lifting from table to floor.
Materials: plastic receptacle (40 x 30 x 26 cm), a wall mounted system with adjustable shelves and weights of 1.0, 2.0 and 4.0 kg.
Procedure: five lifts from table at 74cm to floor and vice versa in standing position within 90 seconds. Four to five weight increments until maximum amount of kg was reached.

Overhead Lifting

Objective: capacity of overhead lifting task.
Materials: plastic receptacle (40 x 30 x 26 cm), a wall mounted system with adjustable shelves and weights of 1.0, 2.0 and 4.0 kg.
Procedure: five lifts from table (74 cm) to crown height and vice versa in standing position within 90 seconds. Four to five weight increments until maximum amount of kg was reached.

Carrying

Objective: capacity of two handed carrying.
Materials: plastic receptacle (40 x 30 x 26 cm), a wall mounted system with adjustable shelves and weights of 1.0, 2.0 and 4.0 kg.
Procedure: 20 meters carrying at waist height with receptacle within 90 seconds. Four to five weight increments until maximum amount of kg was reached.

Postural Tolerance

Overhead Working

Objective: capacity of postural tolerance of overhead working.
Materials: aluminium plate adjustable in height with 20 holes, bolts and nuts and two cuff weights of 1.0 kg each.
Procedure: standing with hands at crown height, manipulating nuts and bolts wearing cuff weights around the wrists. The time that position is held was measured (seconds).

Coordination and repetitive movements

Dynamic Bending

Objective: capacity of repetitive bending and reaching.
Materials: 20 marbles and 2 bowls with a 14-cm diameter positioned at floor and crown height.
Procedure: standing with knees flexed between 0 and 30°, move marbles vertically from floor to crown height as fast as possible. Time needed to remove 20 marbles is scored (seconds).

Repetitive Side Reaching

Objective: capacity of fast repetitive side movements of the upper extremity.
Materials: 30 marbles and 2 bowls with a 14-cm diameter positioned at table height (74cm).
Procedure: sitting with bowls on wingspan distance, move marbles horizontally at table height from right to left with right arm as fast as possible and vice versa. Time needed to move 30 marbles is scored (seconds).

Preceding the FCE tests subjects' age and sex were registered. Length- and weight measurements were performed to calculate Body Mass Index (BMI). Tests were administered by 4th year physical therapy students who had received one-day training in the procedures and the execution of the FCE. They were trained and supervised by the research team.

Statistical analysis

Reference data were matched for age and controlled for sex. For FCE results, two age categories were distinguished to allow analysis of the influence of aging. Because of the small number of male subjects, the data were also compared for the whole group, to increase the statistical power. To answer study questions 1 and 2, SF-36 scores and FCE results of subjects with early OA and of the healthy workers were compared using t-tests. Mean differences and 95% confidence intervals between the groups were analyzed.

Use of the 5th percentile as reference for job demands

The rationale behind the study question about job demands is that the reference data were established to assist clinicians in assessing the functional capacity of a patient. By comparison with the reference values, a patient's capacity can be classified into a physical demand category (sedentary – light – medium – heavy – very heavy) according to the Dictionary of Occupational Titles [DOT;US Department of Labor 1991]. It was assumed that the functional capacity of healthy workers was at least equal to their workload, because they worked 20 hours or more per week, with no absenteeism due to musculoskeletal complaints during 1 year before the FCE. Therefore this capacity may be considered the 'norm' to which the functional capacity of patients can be compared. We chose to compare the results of the subjects with OA to the 5th percentile scores of the reference data on the lowest category, DOT-1 ('sedentary work', with occasionally lifting up to 4.5 kg): if the relatively weakest of the healthy workers can still meet their job demands, their functional capacity may be used as reference point.

RESULTS

Subjects

Subject characteristics and self-reported health status are presented in Table 1. Compared to healthy workers, subjects with early OA were older and less than half of them had a paid job. Females with early OA had a statistically significantly higher BMI than the female healthy workers.

Variable	Males			Females		
	Early OA	Healthy	Mean difference (95% CI)	Early OA	Healthy	Mean difference (95% CI)
n	15	183		78	92	
Paid job (%)	47	100		47	100	
Age in years:						
mean (SD)	58 (5.3)	52 (4.1)	-6 (-8.2 to -3.8) *	56 (4.8)	52 (4.0)	-4 (-5.3 to -2.7) *
range	48 - 65	46 - 61		48 - 66	46 - 59	
BodyMassIndex #	25.8 (5.3)	25.6 (3.9)	-0.2 (-1.9 to 2.3)	26.2 (4.3)	24.1 (3.1)	-2.1 (-3.2 to -0.9) *
SF-36 #						
physical function	80.5 (8.2)	96.6 (5.7)	16.1 (12.9 to 19.3) *	69.8 (22.8)	94.7 (8.1)	24.9 (19.8 to 30.0) *
physical role	80.4 (19.2)	93.1 (19.2)	12.7 (1.3 to 24.1) *	56.6 (43.5)	93.4 (19.6)	36.8 (26.4 to 47.2) *
bodily pain	71.9 (12.7)	90.3 (12.7)	18.4 (11.5 to 25.3) *	64.3 (19.1)	92.1 (9.9)	27.8 (23.2 to 32.4) *
general health	48.2 (13.7)	75.0 (13.7)	26.8 (19.2 to 34.4) *	52.6 (18.7)	76.7 (15.0)	24.1 (18.4 to 29.8) *
social function	92.0 (13.2)	91.3 (13.2)	-.70 (-7.8 to 6.4)	74.5 (20.4)	90.6 (11.8)	16.1 (11.0 to 21.2) *
emotional role	95.2 (15.3)	96.7 (15.3)	1.5 (-6.9 to 9.9)	82.0 (32.9)	91.8 (23.5)	9.8 (1.0 to 18.6) *
mental health	80.6 (10.2)	72.4 (10.2)	-8.2 (-13.8 to -2.6) *	73.7 (13.7)	71.0 (9.0)	-2.7 (-6.3 to 0.9)
vitality	66.4 (11.5)	69.1 (11.5)	2.7 (-3.6 to 9.0)	59.8 (16.6)	66.0 (13.0)	6.2 (1.6 to 10.8) *

* P < 0.05; # mean (SD)

Table 1:
Subject characteristics: differences between early OA (CHECK) and healthy workers

Health status comparison

The subjects with OA reported statistically significantly lower scores than the healthy workers on the physical component of SF-36, for both sexes. On the mental component the CHECK females also scored statistically significantly lower than the healthy subjects, with exception of the mental health scale. The scores on the mental component of SF-36 for the male healthy workers and the males with OA were similar, but on the mental health subscale the men with OA scored significantly higher than the healthy working men. Because of the higher mean age and the small number of the male subjects with OA, afterwards a corrected analysis was

performed, in which they were compared to an age-matched sub-sample of 30 healthy workers (mean age 58). This analysis generated similar results on all scales (not presented here). The healthy working males and females had very similar scores, whereas in the OA subjects the males scored higher than the females.

Functional capacity comparison

The FCE test results for the male subjects are presented for separate age categories and for the total group [Table 2].

Table 2:
FCE performances of male subjects with early OA (CHECK, n=15) and male healthy workers (n=183)

CHECK: 45-54: n=4, 55-65: n=11, All: n = 15; Healthy: 45-54: n=128, 55-60: n=55, All: n = 183

* significant at alpha = 0.05

FCE-test	Age catergory # (years)	Early OA Mean (SD)	Healthy workers Mean (SD)	Mean difference healthy - early OA (95% CI)
Lifting Low	45 - 54	31.8 (7.4)	44.9 (12.3)	13.2 (1.0 to 25.4)*
(kg)	55 - 65	34.1 (6.1)	43.0 (14.5)	9.0 (3.5 to 14.4)*
	All	33.5 (6.3)	44.3 (13.0)	10.9 (7.0 to 14.8)*
Lifting Overhead	45 - 54	19.8 (2.9)	20.1 (4.8)	0.4 (-4.4 to 5.2)
(kg)	55 - 65	17.3 (3.9)	18.9 (4.6)	1.6 (-1.4 to 4.5)
	All	17.9 (3.7)	19.7 (4.8)	1.8 (-0.7 to 4.3)
Carry 2 hand	45 - 54	46.3 (13.4)	46.4 (11.0)	0.1 (-11.0 to 11.3)
(kg)	55 - 65	35.7 (11.5)	43.1 (12.7)	7.4 (-0.9 to 15.7)
	All	38.5 (12.5)	45.4 (11.7)	7.0 (0.7 to 13.1) *
Overhead work	45 - 54	236 (103)	269 (127)	33 (-93 to 160)
(s)	55 - 65	207 (61)	270 (102)	63 (-0.4 to 137.1)
	All	214 (72)	270 (119)	55 (-7 to 117)
Dynamic Bend	45 - 54	51 (7)	47 (6)	-4 (-11 to 3)
(s)	55 - 65	62 (16)	66 (128)	4 (-74 to 82)
	All	60 (15)	48 (7)	-12 (3 to 21) *
Rep. Side Reach	45 - 54	76 (17)	80 (12)	4 (-11 to 19)
(s)	55 - 65	95 (20)	80 (11)	-15 (-30 to 0.0)
	All	91 (21)	80 (13)	-11 (-23 to 2)

The capacity for 'lifting low' was significantly lower in the CHECK men from both age-groups compared to the healthy workers. The other tests showed no significant differences between the subjects with OA and the reference data in the age categories. For the comparisons between the total groups the differences in the tests lifting low, carrying-2-handed and dynamic bending were significant; the healthy workers lifted and carried more weight and were faster on dynamic bending.

In Table 3, the FCE test results for the female subjects are presented.

FCE-test	Age catergory # (years)	Early OA Mean (SD)	Healthy workers Mean (SD)	Mean difference healthy - early OA (95% CI)
Lifting Low	45 - 54	19.0 (6.9)	25.7 (8.7)	6.7 (3.3 to 10.1)*
(kg)	55 - 65	15.5 (6.8)	23.6 (7.3)	8.1 (4.5 to 11.6)*
	All	17.0 (7.0)	24.8 (8.5)	7.8 (5.3 to 10.2)*
Lifting Overhead	45 - 54	9.2 (3.8)	11.5 (3.4)	2.3 (0.8 to 3.8)*
(kg)	55 - 65	7.0 (3.1)	10.5 (3.3)	3.5 (1.9 to 5.1)*
	All	8.0 (3.6)	11.2 (3.3)	3.2 (2.1 to 4.2)*
Carry 2 hand	45 - 54	22.1 (5.6)	28.3 (7.5)	6.2 (3.3 to 9.0)*
(kg)	55 - 65	17.1 (6.4)	26.6 (8.0)	9.5 (6.0 to 13.1)*
	All	19.3 (6.5)	27.7 (7.7)	8.3 (6.1 to 10.5)*
Overhead work	45 - 54	163 (67.8)	239 (111)	77 (42 to 112)*
(s)	55 - 65	157 (79.4)	234 (75)	76 (36 to 117)*
	All	160 (74)	233 (103)	73 (45 to 101)*
Dynamic Bend	45 - 54	55 (16.0)	45 (5.6)	-10 (-16 to -4)*
(s)	55 - 65	64 (15.2)	46 (7.1)	-18 (-24 to -13)*
	All	60 (16)	45 (6)	-15 (-19 to -11)*
Rep. Side Reach	45 - 54	84 (25.8)	74 (9.1)	-10 (-19 to 0.0)*
(s)	55 - 65	90 (15.5)	78 (10.2)	-13 (-19 to -6)*
	All	87 (21)	75 (9)	-12 (-17 to -7)*

Table 3:
FCE test performances of female subjects with early OA (CHECK, n=78) and female healthy workers (n=92)

CHECK: 45-54: n=34, 55-65: n=43, All: n = 77; Healthy: 45-54: n=68, 55-60: n=24, All: n = 92

* significant at alpha = 0.05

The female subjects with OA performed significantly lower than the female healthy working subjects on all tests. In both groups the younger subjects performed higher than the older; the differences were larger in the OA subjects.

Functional capacity versus physical job demands

To assess whether the functional capacity of subjects with early OA was sufficient to meet the physical job demands, the results were compared to the fifth percentile of the results of the healthy workers. In Table 4 these p_5 scores are presented, followed by the proportion of subjects with OA that performed below this cut-off value.

Table 4:
Proportions of subjects with early OA (CHECK) performing below (<) fifth percentile (p_5) of reference data of healthy workers

FCE-test	Age	p_5 score: (DOT-1)	% Males scoring < p_5 (n=15)	% Females scoring < p_5 (n=78)
Lifting Low	45-54	16 kg	0	35
	55-65		0	55
Lifting High	45-54	7 kg	0	33
	55-65		0	50
Carrying	45-54	16 kg	0	20
	55-65		0	45
Overhead Work	45-54	101 s	0	20
	55-65		9	25
Dynamic Bend	45-54	55 s	33	38
	55-65		45	65
Rep. Side Reach	45-54	93 s	0	22
	55-65		0	40

The males with early OA all scored above p_5, except on the dynamic bending test. One of the older males scored below p_5 on the overhead working posture test. On all tests 20-40% of the younger females and 25-65% of the older females scored below p_5.

DISCUSSION

This study revealed that both the 15 male and the 78 female subjects from a subsample from the CHECK cohort at baseline reported a worse physical health status (SF-36) compared to the healthy ageing workers, whereas the females also reported a worse mental health status on 3 out of 4 scales. On the FCE the female CHECK subjects performed significantly lower than their healthy working counterparts on all 6 tests. The male subjects with OA performed lower on 3 out of 6 tests. A substantial proportion of female subjects demonstrated functional capacities that would be considered insufficient to meet the lowest category of physical job demands.

The worse physical health status as reported on the SF-36 can be attributed to the knee or hip complaints of the subjects, but other physical factors may also have influenced their health status. Serious co morbidity was an exclusion criterion for the CHECK cohort, but back pain and other musculoskeletal discomfort were frequently reported. Contrarily, an over representation of physically strong and healthy volunteers in the reference population may have introduced bias that explains part of the observed differences. Still, the early phase of OA is clearly accompanied by self-reported limitations in physical function and physical roles for both sexes and also by mental health limitations for females.

The worse self reported health status of the subjects with early OA compared to the healthy working subjects was also reflected in a lower functional capacity as measured on the FCE. The pain and stiffness in the hips or knees, possibly in combination with other health complaints, seem to have affected their performance in work related physical activities. We reported earlier that in this sample the subjects with low self-reported functional status showed lower performances on the FCE [26].

About half of the subjects with early OA in this study did not have a paid job. Either or not having a paid job has been reported to explain part of the performance on an FCE [11]. For example, on 'lifting low' the average difference between females from this study with paid work and those without paid work was 4.7 kg (19.4 kg versus 14.7 kg). However, after correcting for this factor, there still remains a substantial difference between the capacities of the working subjects with early OA and the reference group of healthy workers. Therefore it was concluded that in the early phase of OA of the hips and knees a decreased functional capacity is seen, both in working people and even more in people without paid work. The impact of the OA, as measured by self-reports and an FCE and compared to healthy workers, seems to be stronger in females than in males, both physically and mentally. Mental health factors may be related to having a job, either because a job requires for example vitality, or because of the social relations that a job may offer. Since many women in the study never had a job, this may explain the differences with the men.

The basis assumption for clinical interpretation of the results was that the functional capacity of healthy workers, used as reference data in this study, is equal to or exceeding their workload. For this reason these data may be considered the "norm" to which the functional capacity of the subjects with OA could be compared [13]. To be precise, the p_5 scores of the reference data for working subjects with the physically least demanding jobs (DOT-1; sedentary work) were used as reference. A substantial proportion of the female CHECK subjects performed lower than this p_5 score. For the persons with paid work amongst them, the low performance indicated that they could be considered to be at risk of not meeting their physical work load. For those without paid work a low functional capacity might impair their physical activities of daily living (ADL) and leisure. The influence of OA on role participation has been identified as an important research issue [27;28]. The subjects without paid work formed the majority of the group who performed lower than p_5, which is consistent with the earlier discussion on the relation between having paid work and FCE performance.

It may be argued that only OA patients who are physically functioning relatively well are able to perform paid work and to live an active lifestyle in ADL and leisure. However, work and an active life-style can also be postulated to have beneficial effects on physical functioning and health. Physical activity in Japanese women with hip OA was related to both work status and to the degree of OA, but only the women without paid work were physically inactive, whereas the workers were not [29]. The hypothesis of a physically conditioning effect of work and an interaction with life-style seems to be supported by other observations in our study. The female healthy workers had a significantly lower BMI than the females with early OA (24.1 versus 26.2). The smaller impact of early OA on health and functional status in males compared to females could also illustrate the conditioning effect of work. The males without paid work only recently retired and may still have had the conditioning benefit of their past working life, whereas many of the females reported never to have had paid work. Furthermore, the females also performed lower on FCE tests that do not relate to knee or hip function, such as working overhead. Yet, considering the cross-sectional nature of our study and the small number of male subjects, full explanations for these observations can not be given. The relations between work, health status and functional capacity should be studied longitudinally.

Another limitation of the study is that no more than 6 tests in our protocol matched those from the reference study. However, these tests cover the aspects of strength, static endurance and speed/mobility. Together, this should provide a valid impression of the ability to perform work related activities, relevant for people with early OA. The validity of shorter FCE protocols, which obviously have practical advantages, has been demonstrated in a recent study [22]. Several alternative explanations besides the OA may theoretically explain parts of the differences in results between the groups, as for example testing order and fatigue, age, and willingness to give maximal effort. Considering age, the CHECK subjects were up to 65 years old whereas the oldest working subjects were 61. Soer et al. [13] constructed a regression model for predicting the result on 'lifting low' in which the coefficient for age was -0.2 kg/year. Applying this value to the difference in mean age between our groups (6 years for males, 4 years for females) would generate

an expected difference of 1.2 and 0.8 kg. respectively. Clearly the differences we found were much larger than could be expected only on the basis of the age difference. Hence, it appears that the functional limitations of the subjects with early OA should actually be attributed to the observed lower capacity that accompanied their complaints.

Functional capacity is one of the several components that determine work ability and social participation [5;28]. Experts in the field of disability claims and return to work have different opinions on the utility of FCE [30], but FCE information had complementary value according to most insurance physicians [31]. Our study indicates a potential preventive use of FCE. The results demonstrated that less than half of the subjects with early OA had paid work and that both their self-reported health status and their functional capacity were significantly lower compared to healthy working subjects. A substantial proportion of women did not meet the physical job demands. Therefore, considering the aim to increase the work participation, (preventive) interventions would be needed. For the workers amongst our subjects, adapting the working situation and maintaining functional capacity is recommendable. For others who consider finding a job (again), increasing their functional capacity and selecting jobs without heavy physical demands is advisable to facilitate actual work participation.

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Chapter 8

Physical function in women with early osteoarthritis: what is the relation with functional capacity, work participation and self-reported activities?

Submitted

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ABSTRACT

Objective

The insight in movement behaviour and physical function of people with osteoarthritis is incomplete. Therefore we determined the relation between self-reported physical function, performance on a Functional Capacity Evaluation (FCE), work participation and activities in spare time.

Methods

78 Women from the Cohort Hip and Cohort Knee (CHECK) study on early osteoarthritis participated. Physical function was measured with the WOMAC questionnaire; based on the scores, the women were divided into 3 groups of 26 (group 1-least limitations, group 3-most limitations). Functional capacity was assessed with the WorkWell Systems Functional Capacity Evaluation (FCE). Work participation and physical activities were measured with a questionnaire. To test the relation between physical function and functional capacity in the whole group, Spearman rank correlation coefficients (ρ) were calculated. Differences between the 3 groups in functional capacity, work participation and activities in spare time were tested with one-way analysis of variance, non-parametric rank tests and Chi^2-tests.

Results

Mean WOMAC scores of the 3 groups were 6, 17 and 34, respectively. Correlations between WOMAC score and FCE performance varied from -0.32 to -0.46. Differences in FCE-scores were found between the groups, group 1 scored better than group 2 on most tests and group 2 scored better than group 3. The proportion of women with paid work in the groups 1, 2 and 3 was 70%, 57% and 26% respectively. Lastly, groups with better WOMAC scores reported higher levels of activities in spare time. Group 3 demonstrated by far the most limitations.

Conclusion

The WOMAC-score for physical function showed relations at group level with all 3 outcome measures: better physical function corresponded with higher functional capacity, higher work participation and more physical activity. Physical therapists can use the WOMAC to estimate the movement behaviour of women with early osteoarthritis.

INTRODUCTION

Osteoarthritis (OA) has the highest prevalence of all musculoskeletal disorders. It increases with age and is more prevalent in women than in men [1]. Recent figures indicate that one in seven Dutch people older than twenty years suffer from OA, 1.8 million people all together [2]. The disorder is mostly located in the joints of the hands, hips and knees. Physical movements may become painful and the patient may tend to become physically less active [3], which goes along with worse physical function [4].

There is no treatment that can prevent or cure OA. According to the guideline osteoarthritis hip-knee of the Royal Dutch Physical Therapy Association (KNGF), well-dosed physical activity has beneficial effects on the function of people with OA and the importance of movement programs is emphasized. It is not entirely clear what type of activities have a positive effect on physical function [5]. Certain loads during occupational activity, such as lifting heavy loads, jumping and work in kneeling positions are risk factors for developing OA [6-9]. But intermittent loads, on the other hand, have a positive effect on OA [5]. Therefore, insight in movement behavior during work and spare time is important to assess both its risks and its positive effects.

Physical function can be measured in several ways, for example by self reporting, by professional judgment and by physical testing. The KNGF guideline advises the use of a self report instrument, the Algofunctional Index for Osteoarthritis (AIO). In international research mostly the Western Ontario and McMasters Universities Osteoarthritis Index (WOMAC) [10] is used. Examples of professional judgment are the procedures performed by occupational physicians and insurance physicians to assess limitations in functional capacity and to decide whether an individual is eligible to receive financial disability compensation [11]. A physical therapist may use a test protocol to determine the starting level or the effect of therapy, for example in patients with rheumatoid arthritis [12].
To assess physical function during work, i.e. the capacity to perform work related activities, occupational physical therapists can use a Functional Capacity Evaluation (FCE) [13], for example on OA patients [14]. All these different methods to establish physical

function do not always generate identical results [15-17]. For example, there is only a moderate correlation between self reporting with WOMAC and performance in ADL activities such as walking and getting up from a chair [18-20]. Performance measures as functional capacity, or either or not having a paid job, have not been studied yet in people with OA. Therefore, the insight into the movement behavior and the physical function of people with OA during work and spare time is incomplete.

Furthermore it is not clear what the best way is to measure physical function in early OA. For this reason our research question was if there is an association between on the one hand physical function measured with WOMAC and on the other hand functional capacity, participation in paid work and physical activity during spare time. The question was divided in two sub questions:
What is the correlation between WOMAC scores and FCE performance?
Are there any differences between subgroups that were formed, based on WOMAC scores, in FCE performance, work participation and level of activity in spare time?

METHODS

Design and procedure

This study concerns a cross-sectional study in the 10-years prospective CHECK study (Cohort Hip and Cohort Knee) [21] with 1002 participants, included by 10 regional centers. They take part in a periodical standardized medical examination and fill in a set of questionnaires on health, symptoms, limitations, social participation and health care consumption [22]. Furthermore, the subjects from Groningen and Twente were invited to participate in an FCE. Patients who agreed to participate performed the FCE as shortly as possible (within a few months) after the medical examination and the filling of the questionnaires.

Subjects

The inclusion criteria for the CHECK study were having hip and/or knee complaints for which the subject visited the general practitioner for the first time no longer than 6 months ago. Complaints were not attributable to a direct trauma or an other disorder (particularly inflammatory disorders as for example rheumatoid arthritis). The age of the subjects was between 45 and 65 years. Exclusion criteria were the presence of a rheumatoid disorder, a joint prosthesis (hip or knee) and serious co morbidity. The prevalence of OA is higher in women, both in the general population and in CHECK [21]; because a previous study showed that men performed better than women on an FCE [14], sex could be a confounder in this study. Moreover, since there were only a few male participants, it was decided to perform the study only on the female subjects.

All subjects agreed with participation after receiving comprehensive verbal and written information (informed consent). The study was approved by the Medical Ethical Assessment Committee of the Medical Spectrum Twente in Enschede, the Netherlands.

Measurements

The instruments that were used were WOMAC, FCE and the part of the questionnaire about work participation and physical activities.

Self reporting, physical function: WOMAC measures 3 aspects of OA, namely pain, stiffness and physical function. In this study only the 17 questions on physical function were analyzed. These items asked for perceived difficulty during activities of daily life, rated from 0 (no limitations) to 4 (many limitations) points, therefore the maximal score for physical function was 68. The Dutch WOMAC version was used, which was proven to be reliable and valid [23;24].

Performance test, FCE: The standard WorkWell Systems FCE consists of 28 tests that assess the capacity to perform work related activities. For this study 22 tests were selected that mainly stress the hips and the knees. The load was increased stepwise until the maximum was reached. The test leader judged safety and level of effort, using a standardized observation protocol [25]. Subjects were free to end the test at any moment, for example because of pain or discomfort. Tests addressed strength, velocity and endurance. Each test measured a work related activity, such as walking, stair climbing, lifting, carrying, maintaining a body posture and creeping. Test-retest reliability of the FCE in people with early OA is sufficient [14]. Most FCE studies have been performed on healthy individuals or individuals with chronic low back pain. The CHECK study is the first study that applies FCE on individuals with OA. Measurements were led by fourth year physical therapy students who were trained in the execution and procedures of the test. They were supervised by teachers/senior research staff.

Self reporting, work participation: in this section of the questionnaire [26] subjects were asked whether they had a paid job, and if yes, for how many hours per week. Eight hours or more was used as criterion for 'paid work'. Working subjects were asked to indicate job type and work load by questions about walking, sitting, squatting and heavy lifting.

Self reporting, level of physical activity: in this section subjects were asked to indicate to which degree they performed physical activities in spare time, such as light house keeping, walking and cycling, shopping and heavy do it yourself work. Answering options were 'seldom or never', 'occasionally', 'often' or 'very often'. These activities can be expressed in metabolic equivalents (METS)[27]; one MET is the energy use of a resting person.

Statistical analysis

Based on their score on WOMAC scale 'physical function', the subjects were divided in three groups (tertiles) of equal size. Group 1 was the group with the least limitations, group 3 the group with the most limitations. The 3 groups were compared with regards to the 3 variables that were measured: functional capacity, work participation and physical activity.

Functional capacity

To test the relation between WOMAC and FCE scores, Spearman rank correlation coefficients (ρ) were calculated.

Differences in functional capacity between the 3 groups were tested using analysis of variance. For continuous variables with a normal distribution (such as lifting, carrying and pushing) one-way anova (F-test, alpha = 0.05) was used; for variables without a normal distribution, and the tests with a pre-set end criterion (endurance time, speed or distance) a non-parametric test (Kruskall-Wallis, alpha = 0.05) was used. To analyze between which subgroups the differences appeared, post-hoc tests with Bonferroni correction for multiple comparisons were applied.

Work participation

Differences in work participation (nominal variable: paid work or no paid work) between the 3 groups were tested with Chi-square tests (2 degrees of freedom).

Activity level in spare time

To present the levels of physical activity in spare time of the 3 groups in a clear and discriminative way, the 10 activities were dichotomized by putting together the answer categories seldom or never and occasionally as 'infrequently' doing these activities, and often and very often to 'frequently' doing these activities. Differences in activity level between the 3 groups were tested using Chi-square tests (2 degrees of freedom).

RESULTS

Subject characteristics

The participants in this study were 78 women; characteristics of the 3 Groups of 26 subjects are presented in Table 1. There was a statistically significant difference in the mean WOMAC scores of the 3 Groups (Kruskall-Wallis test, P<0.001). The score range in Group 3 was larger than in the other 2 Groups. There was no difference in mean age of the groups.

Table 1:
Subject characteristics

		Group 1 (n=26)	Group 2 (n=26)	Group 3 (n=26)
Age (years)	Mean (SD)	55,4 (4,2)	56,4 (5,5)	56,9 (5,1)
	Median	56	56	57
	Range	48-63	47-65	48-65
WOMAC score physical function	Mean (SD)	6,0 (3,6)	17,0 (4,3)	34,0 (5,3)
	Median	7	17	33
	Range	0-11	11-26	27-49
Paid Work	% Women who have paid work	70%	57%	26%

FCE

The correlation coefficient (Spearman's ρ) of the association between WOMAC and the 2 lifting tests and the 3 carrying tests of the FCE of all 78 subjects varied from -0.32 to -0.46.

Table 2:
Results of the FCE strength tests

* Anova statistically significant (p<0,05)

** post-hoc significant difference compared to Group 1 (p<0,05; Bonferroni)

FCE-activity	WOMAC Physical Function (Mean Score (SD))			P-value
	Group 1 (n=26)	Group 2 (n=26)	Group 3 (n=26)	
Lift Low (kg)	19,0 (7,6)	16,9 (6,4)	15,3 (6,7)	0,173
Lift High (kg)	9,1 (4,0)	7,8 (3,5)	6,8 (3,4)	0,083
Carry Short (kg)	19,4 (7,0)	18,7 (6,2)	14,0 (6,4)**	0,008*
Carry Long, 2-hands (kg)	22,0 (5,8)	20,1 (6,7)	16,0 (5,7)**	0,003*
Carry Long Right (kg)	22,0 (5,6)	19,5 (6,6)	16,4 (5,6)**	0,007*
Carry Long Left (kg)	21,8 (5,6)	18,7 (7,2)	15,5 (5,9)**	0,004*
Static Push (kg)	25,7 (8,0)	25,5 (7,7)	20,9 (7,6)	0,064
Static Pull (kg)	32,4 (7,0)	31,2 (9,7)	25,1 (10,4)**	0,016*

In Table 2 the mean scores of the 3 Groups on the strength tests of the FCE are presented. Group 1 (best WOMAC scores) had better results than Group 2 on all strength tests, and Group 2 had better results than Group 3 on all tests. On all 4 carrying tests these differences were statistically significant; the differences between Groups 2 and 3 were larger than those between Groups 1 and 2. Post-hoc analyses showed that the statistically significant differences were found between Groups 1 and 3.

FCE-activity	WOMAC Physical Function (Median)			P-value
	Group 1 (n=26)	Group 2 (n=26)	Group 3 (n=26)	
Endurance (seconds)				
Static overhead work	178	149	136**	0,019*
Static standing work with bent back	432	285	293	0,068
Kneeled position	300	300	233**	0,002*
Speed (seconds)				
Crouching	46	50	50	0,624
Squatting	60	60	60	0,351
Dynamic standing work with bent back	53	54	62	0,021*
Repeated squatting	46	49	55**	0,003*
Repetitive rotation standing, left	77	83	88**	0,033*
Repetitive rotation standing, right	77	77	85	0,063
Repetitive rotation sitting, left	83	85	93	0,228
Repetitive rotation sitting, right	83	86	91	0,061
Distance (meters)				
Walking, cumulative distance	420	330	250**	0,031*

Table 3:
Results of the other FCE tests

* non-parametric Anova statistically significant (P < 0,05)

** post-hoc: significant difference compared to Group 1 (P < 0.05; Bonferroni)

In Table 3 the scores of the 3 groups on the other FCE tests are presented. On almost all tests group 1 had better results than Group 2, and Group 2 had better results than Group 3. The only exceptions were static standing work with a bend back and squatting, which showed hardly any differences between the groups. These results indicate again that on most tests the differences between Groups 2 and 3 were larger than those between Group 1 and 2.

Work participation

Table 1 indicates that the work participation of women with early OA is lower when their physical function, reported with the WOMAC, is worse. The work participation in Group 3 is 44% lower than in Group 1; this difference is statistically significant (Chi^2 = 11,2; p=0,004).

Physical activities in spare time

Figure 1 shows the levels of physical activity of the women in the sub-cohort. Group 1 was more active than groups 2 and 3 on 7 of the 10 activities. These differences were statistically significant for walking/cycling (Chi^2 =10.1, p=0.007), light gardening (Chi^2 = 14.4, P=0.001) and heavy gardening (Chi^2 = 7.8, p = 0.02). There were no differences in sitting activities, light do it yourself work and heavy do it yourself work; this last activity was only performed by a small number of subjects. The other activities showed a relation between self-reported physical function and self-reported physical activities: lower WOMAC scores (better physical function) were associated with higher physical activity levels.

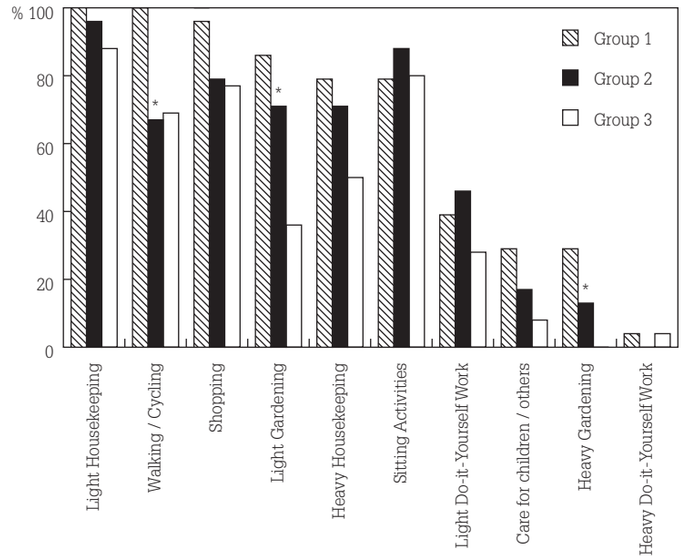

Figure 1:
Physical activity in spare time: proportions who frequently perform these activities, per group.

Group 1 had the lowest WOMAC score (least limitations),

Group 3 the highest score (most limitations).

* Chi-square: P <0.05

It appears from Figure 1 that either or not performing an activity is associated with the load of the activity, expressed in metabolic equivalents (MET). Activities such as light housekeeping, walking and cycling correspond with about 2 METs, and these were performed by a large proportion of the women. Heavy housekeeping, heavy gardening and heavy do it yourself work (27) correspond with 4-5 METs. Figure 1 indicates that these activities were performed only by a small proportion of subjects.

DISCUSSION

The results of this study demonstrated that in women with early OA of the hip and knee, a better level of physical function on the WOMAC corresponded with a better functional capacity, higher work participation and more physical activity in spare time. The findings on these 3 effect measures showed clear differences between the 3 subgroups that were formed on the basis of WOMAC scores. Differences were found almost without exceptions on all variables, which indicates that there is a relation on group level between physical function and movement behavior during work and spare time. However, within the groups there is variation, that is expressed in the low to moderate correlation coefficients, and that indicates that there are more factors that influence this movement behavior.

Group 3 scored 34 points on average on the WOMAC subscale physical function, which has 68 as maximum score. That is on average 2 points on 17 different activities, meaning that several daily activities were moderately restricted, or a few activities were strongly restricted. Compared to groups 1 and 2 (6 and 17 points respectively) this score is remarkably high, considering that all subjects were included because of beginning complaints of the hip and knee. There is a wide range in the degrees of perceived restrictions in physical function at this baseline measurement. This may be explained by an already existing less active lifestyle of some of the subjects, or by the presence of other physical complaints besides the hip and knee symptoms. Another explanation may be that certain subjects waited longer before they consulted their general practitioner, and therefore were in a more progressed stage of OA. Identifying this sub-group with strong restrictions in physical function in the early disease stage is important, in order to be able to evaluate the risk of further deterioration and to decide on the need of effective interventions.

Considering the relation at group level between WOMAC and FCE, the WOMAC questionnaire can be used to indicate the capacity to perform work-related activities: better WOMAC scores are associated with better performance on an FCE. However, the FCE is time consuming and a physical burden, whereas the WOMAC offers

the opportunity to get a quick impression of a subjects' physical function during work, without the physical stress of a test. Higher WOMAC scores (more restrictions) are also associated with a lower work participation, in group 3 26% had a paid job. In the general female population of the same age this was 44% [28].

A weakness of this cross-sectional study was that no causality of relations could be proven, i.e. whether the decreased physical function led to lower work participation, or that quitting paid work or decreasing physical activity caused the worse physical function. Only very few subjects mentioned their health as reason for not doing paid work. This makes a negative influence of symptoms in this stage of OA on work participation unlikely. However, not having a job may lead to a worse physical condition and a lower physical work capacity; this mechanism may have influenced the physical function of the nonworking women. Hirata [29] studied the physical activity of Japanese women with hip OA, using an accelerometer to count their steps. The working women were more active than the nonworking women, and those with mild OA were more active than those with serious OA. There was also interaction: only the women with more progressed OA who had no paid work were physically inactive, those who worked were not inactive. This suggests that work can be an important stimulus for physical activity.

Although our study described relations between physical function, work, functional capacity and physical activity, a weakness was that other determining factors were not analyzed. These analyses have been described for the whole cohort, with 1002 subjects; here the workers appeared to have a better self-reported physical health than the nonworkers, but the mental health was similar [30].

Regarding most of the physical activities, a higher level was associated with better WOMAC scores. The exceptions were sitting activities, and light and heavy do it yourself work. An obvious explanation for the first part of this observation is that sitting causes no high physical load. A larger proportion of women performed an activity if this demanded less effort (METs, [Figure 1]). METs refer to energy use, but not to pain or restrictions. A decreased physical function may be associated with a worse physical condition and endurance, which could be the reason why these women get tired

sooner and give up these activities. An exception to this observation is heavy housekeeping; this demands a lot of METs and is performed frequently. A traditional role division between women and men of this age may explain this.

Considering the KNGF guideline and the review of Vignon, people with early OA of hips and knees should be strongly advised, e.g. by physical therapists, to perform physical activities. Because OA is an irreversible disorder, secondary prevention is important for people with early symptoms, aimed at slowing down its progression. Intermittent physical load of moderate intensity, as in the movement programs that have been developed for OA patients, has a positive effect on physical function of people with OA [4]. Both the absence of load and too heavy loads have a negative effect on the progression of OA. Activities should not cause pain or joint trauma. Our study confirms this recommendation, because less activities in work and spare time were associated with a negative trend in the level of physical function.

Implications for practice

On the level of groups, there was a relation between physical function as reported with the WOMAC, and functional capacity measured on the FCE, work participation and physical activities in spare time. The application of WOMAC is simple: patients can independently fill out the questionnaire in 5 to 10 minutes. The KNGF guideline osteoarthritis hip-knee recommends the use of the Algofunctional Index for Osteoarthritis (AIO), that contains 5 questions on physical function, 3 of which are specifically for the knee or the hip. The WOMAC is more elaborate, with 17 items on physical function, but it does not differentiate between knee and hip symptoms. The WOMAC also contains more questions on pain and stiffness than the AIO. Considering the widespread international use of the WOMAC, the guideline committee might think about recommending this questionnaire as self-report instrument in early OA.

Compared to the WOMAC, measurements with FCE are a burden for subjects. They take a lot of time for the patient and the test leader, a complete test lasting about 2.5 hours. Therefore, the WOMAC can be used to estimate the work capacity of women with early OA. However, the observed variation within the 3 groups implies considerable impreciseness in the estimates for individuals. Therefore, if the work capacity needs to be evaluated precisely, referral to an FCE center is advised. FCE's are generally applied by physical therapists who work in the setting of work rehabilitation. They collaborate with occupational physicians and insurance physicians in answering questions about the work ability of patients. Formal decisions on work (dis)ability and return to work are not taken by the physical therapist.

In summary, this study demonstrated that the WOMAC can be used to estimate the physical function of women with early OA during work and spare time. Because the use of the WOMAC is easy and time-saving, its application in the physical therapy practice is recommended.

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Chapter 9

General Discussion

INTRODUCTION

The studies presented in this thesis analysed participation in paid work of 1002 subjects from the Cohort Hip and Cohort Knee (CHECK-study) and additionally assessed the work capacity of a subgroup of 93 subjects from the cohort, with a Functional Capacity Evaluation (FCE). Also a systematic review of the literature on work participation in osteoarthritis is presented. In this concluding chapter the main findings of the thesis are summarized, as well as an overall discussion of these findings and of some methodological issues. Finally the implications and the recommendations are formulated.

MAIN RESULTS

Many authors refer to arthritis as a major cause of disability and as a disorder with a high disease burden [1-3]. This implies that arthritis has a large socio-economic impact: it causes a lot of limitations in people's daily life and generates high costs: direct health care expenses and indirect expenses, of which reduced work productivity and missed work days are frequently mentioned to be major causes. Although the prevalence of osteoarthritis (OA) is much higher than of rheumatoid arthritis (RA), the majority of literature regarding the burden of arthritis is about RA. Moreover, in articles about OA reliable data on the impact on work are difficult to find [4;5]. For this reason within this thesis a systematic literature review was performed.

Our systematic review identified 14 articles on the effect of OA on work. Most of these addressed work only as a secondary issue and because mostly older subjects were included, little valid information was found. Because clear evidence on the effect of OA on work participation was unavailable, conclusions were drawn with reservation. With this reservation it was concluded that for most working individuals with paid work their disorder may generate some difficulties at work, but consequences for sick leave and early retirement were not disproportionate. For a minority OA leads to substantial loss of work days, but co morbidity, age and education level may also play an important role here. This emphasises the value of the CHECK study, being an inception cohort of primary OA of hip and knee in patients aged 45-65 at inclusion, offering an excellent opportunity to study the course of work participation in this common musculoskeletal disorder.

Two original own studies on the course of OA with regard to work participation were part of this thesis [Chapters 3 and 4]. At baseline 51% of the cohort subjects had paid work (8 hours or more per week). Only a small minority of the people without a job indicated not to work because of hip/knee complaints or other health complaints. Main reasons for not working were being a housewife, retirement, doing voluntary work and combinations of these reasons. A comparison, stratified for age, sex and education level, showed that this participation rate was similar to the general

Dutch population, but much lower than in a comparable American OA cohort. In both cohorts subjects with paid work reported slightly better health and physical functioning than subjects without paid work. At 2-years follow up the participation rate decreased from 51% to 46%. This reduction again was similar to the decline in the general Dutch population. Age was the only significant determining or explaining factor for continuing or giving up work.

Comparing the self-reported health of non-working subjects to workers without sick-leave and workers reporting having been on sick-leave, the last group reported significantly poorer results. The prevalence of sick-leave did not change from baseline to follow-up. The numbers of subjects, who had work adaptations increased in two years from 14% to 20%.

OA of hips and knees often causes functional limitations. In research these limitations are mostly measured by patient self-reports or tested in low intensity functional measurements of activities of daily life (ADL) that are relevant for elderly, for example getting up from a chair and walking. The aim of this thesis was to examine the impact of OA on work and therefore the functional capacity to perform work related activities such as lifting, carrying or working in static postures was evaluated. Ninety-three CHECK subjects participated in a Functional Capacity Evaluation (FCE). The reproducibility of the FCE lifting tests in OA was sufficient at group level (presented as Intra Class Correlation, ICC), but there was substantial intra-individual variation (Limits of Agreement, LoA; Chapter 5). In Chapter 6 a diagnostic model was developed to test the predictive value of self-reported physical function in predicting performance on the FCE. Low self-reported physical function on both SF-36 and WOMAC predicted low performance on the FCE, but also many subjects with a good self-reported physical function were labelled to have work limitations on the FCE.

A comparison of self-reported health (SF-36) and functional capacity between people with OA and data from healthy workers [6] revealed that both parameters were significantly lower in the former group [Chapter 7]. Within the subjects with OA, the workers performed better than the non-workers, but still lower than the healthy controls. The last study, on 79 female CHECK subjects, demonstrated that a better self-reported physical function was associated with having paid work, a better functional capacity and a higher level of self-reported physical activity in daily life.

In conclusion, there was no clear impact of suspected early OA on the work participation rate in our cohort participants during the first 2 years of the study. However, a number of possible early signs of an impact of OA on work, health and capacity were noticed:

- a substantial number of realized and desired work adaptations and an increase of these at 2-years follow-up,
- a worse self-reported health and functional capacity of CHECK subjects compared to data from healthy workers,
- a significantly worse self-reported health and higher medical consumption in CHECK subjects reporting sick-leave, compared to CHECK subjects who reported no sick-leave,
- presence of other health complaints besides hip and knee that have influence on work participation.

These early signs may indicate a need for intervention, especially when it concerns subjects with characteristics that make them vulnerable for becoming work disabled and giving up work. Based on this study, poor self-reported health and physical function, co morbidity and sick-leave are the signs that demand attention.

DOES EARLY OA OF HIPS AND KNEE AFFECT WORK PARTICIPATION AND WORK CAPACITY?

The observed mild impact of OA on work in the CHECK study is different from the findings in a number of studies that were included in the systematic literature review. A conclusion of this review was that there are just a few studies of good quality describing the impact of OA on work participation. Many suffer from confounding by including older and lower educated patients with obvious co morbidity. Although economical evaluations were not the aim of this thesis, it is worth noticing that several studies estimated work productivity losses. This was done without presenting primary results on this factor, nevertheless presuming that the reduced work productivity causes a substantial part of the indirect costs of OA. Furthermore results were sometimes not presented in a clear manner, which made it very difficult to verify or reproduce them. This observation emphasises the need of well designed, valid studies to examine the effect of OA on participation in paid work.

Regarding OA and work, two opposite trends can be distinguished in the general Dutch population: OA prevalence increases with age [7] whereas work participation decreases with age, especially between 55 and 65 years [8]. In the introduction of this thesis, this observation was presented as background and context for the studies that were performed. As demonstrated in Chapters 3 and 4, the participation rates in the CHECK cohort and the general Dutch population are similar. A combination of this result with the statistics on OA prevalence results in an estimate of 60.000 working men with OA and 40.000 working women with OA in the population aged 45 to 65 years in the Netherlands.

Looking at absolute numbers, more working men than women are affected by OA, but expressed as proportions equal shares of working men and working women are affected overall. After the age of 55 the prevalence and incidence of OA of women increasingly exceed that of men. This has never appeared as an occupational health issue, because it was concealed by the Dutch 'tradition' that men were breadwinner and women housewives. However, the governments intention is to increase the work participation, especially of women and of citizens older than 55. If this intention is carried through, the disabling effect of OA on health and functioning may become more visible, or it may even obstruct the objective of increasing work participation. Different effects of arthritis on work for men and women have already been described in North America. Women may be more likely to leave employment, whereas men may be more likely to remain working and report negative workplace experiences [9;10]. Therefore, these differences may need specific attention when interventions aimed at increasing work participation will be developed.

In a 2-years follow-up period, as in the CHECK cohort on early OA, established work disability with financial compensation as an outcome can hardly be expected, because the legal/formal procedures that precede disability generally take 2 years. Since the complaints in OA mainly occurr periodical, periods of continuous of sick leave are not expected. Very few subjects reported long lasting sick-leave and neither were hip or knee complaints reported frequently as reasons for not participating in paid work. Two recent publications from other countries showed serious effects of OA on work, in the form of giving up work [11] and receiving work disability compensation [12]. The impact of OA on work may change, depending on the duration, course and progress of the disease, which can be very different between individuals. Longitudinal studies are required to get better insight into this process and its determining factors.

Comparing international literature on this issue carries a methodological risk, regarding generalization. There are important differences between countries in health care, social security and insurance systems, and the influence that governments and employers have. This probably has major effects on work participation, sick leave and return to work after sickness or disability. Nevertheless, our studies contribute substantially to new insights into the relation between work and health in the Dutch situation.

All clusters of the ICF model [13] were addressed and many possible relations discussed. The impact of OA on participation in paid work is not the result of a simple linear process. Several fac-

tors concerning the disease, the person and the environment play a role in this process and their interactions are multi-directional [14]. Obviously, pain and stiffness caused by OA may reduce a subjects' work capacity and lead to problems in the work situation. However, the extent of these problems may be less for an office worker than for a waitress in a restaurant; and when the waitress maintains a good physical condition, the problems may be less than when she avoids exercise. An important implication of this hypothesis is that interventions can be aimed at every element in the process, for example in the form of work adaptations, exercise therapy, medication or cognitive therapy. The effectiveness of interventions on work ability has to be investigated.

Interventions can be developed on a scientific basis since the knowledge about modifiable risk factors for impairments and disability in different types of arthritis increases [15]. This stimulates the awareness for the importance of prevention. Lifestyle factors as eating habits and physical activity patterns are increasingly being addressed. At the same time evidence on determinants of work participation and disability is implemented in guidelines for occupational health professionals. Collaboration between clinicians from the settings of general and occupational health care is needed to enable people with health problems to remain working. An example is the introduction of the issue of 'work ability'[16-18]. Monitoring of employees' health and fitness, life phase oriented Human Resources Management, and ergonomic interventions are tools that can be used. Programmes for health promotion and health management are introduced [10;19].

Our study demonstrated that 6% of the working subjects have decreased their working hours because of their hip or knee symptoms, it was the most frequent adaptation. Very little subjects reported having seen the occupational physician. People may not be aware of available interventions to maintain work ability or procedures to receive workers' compensation. Another possibility is that they have the ability to make early adaptations by themselves. The 5-year follow-up study will be important to see if any subjects became work disabled.

METHODOLOGICAL STRENGTHS AND WEAKNESSES OF THE STUDIES

An important strength of our study was the large, prospective inception cohort: inclusion was limited to subjects with suspected early OA, thereby reducing the impact of disease duration and selection biases on the results. Important exclusion criteria were pathologic conditions other than OA that explained the existing symptoms, other rheumatic disease, ligament or meniscus damage, and previous hip or knee joint replacement. As the literature review made clear, a lot of studies on work participation in OA patients are prone to confounding. The included patients were often older and lower educated than the control groups to which they were compared, and sex and education level are by themselves strong determinants of work participation. Also OA patients may have been exposed more to physically heavy work. As mentioned in the introduction, this is a risk factor for developing OA of hips and knees and as such this may modify the relation with work participation.

In our study we compared the CHECK subjects to the general Dutch population, matched for age, sex and education level and to the American Osteoarthritis Initiative (OAI) cohort study. Different from the literature we found no severe impact of (early) OA on work participation, probably because the referred studies were biased as mentioned, but also because of the very early disease stage of our subjects. Nevertheless, we noticed several possible early signs of work problems, although interpretation is difficult. The results of the comparison with the general population, with the OAI and with healthy workers justify the conclusion that in the first 2 years most working subjects with OA appear to cope with their physical problems. However, a small proportion of early OA subjects are vulnerable and at risk for work disability.

The CHECK study was set up as a broad study on the course of OA, with a wide perspective on health as described in the ICF model. Comprehensive questionnaires were used [20] to cover all areas of interest. In the analysis of the data sets of 1002 subjects concerning the items on work, some inconsistencies were seen. These may be the result of subjects not complying with the instructions or of

using terms and concepts without clear definitions. An example is the item on work status, where one of the options was “I am work disabled”, but it was unclear whether this was related to receiving disability compensation or a self-report on perceived (dis-)ability. Better instruments need to be developed and used [21-24] Another example is the way in which subjects have adapted their work, but where the involvement (either supportive or obstructive) of employers and occupational physicians is unclear. To get more insight into these matters, the use of a more extensive work questionnaire or additional qualitative studies is recommended.

Questionnaire measurements were supplemented by and compared to the measurement approach of performance testing in the FCE studies on 93 subjects from the CHECK regions of Groningen and Twente. New evidence was added to the important discussion on how to measure (dis-)abilities, either by self-report or by performance testing [25;26]. The general idea that the two approaches generate different information and therefore should be used additionally [27] was supported by our data. A perhaps surprising result of the diagnostic study on the relation of self-report (SF-36 and WOMAC scales for physical function) was that the highest predictive value was observed for a positive test. This means that subjects with a low self-reported physical function subsequently performed poorly on the FCE. This can be interpretated as indication for a valid diagnostic test, but a self-fulfilling prophecy can not be excluded. The predictive value of a negative test was much lower, meaning that many subjects reported no functional limitations, but nevertheless performed below the established cut-off score of lifting 22.5 kg on the FCE. Although this cut-off score may be critized, it made clear that performance testing on an FCE should be considered in matters regarding the work capacity of subjects with early hip or knee complaints.

NEW KNOWLEDGE GENERATED BY THIS THESIS

Studying the impact of OA on work participation in a large prospective study like CHECK is quite unique and offered valuable insights. The broad coverage of health related variables enabled analyses on relations between the outcome measure of interest in this thesis, work participation, and several clinically measured and self-reported factors. Furthermore, comparisons were ‘calibrated’ against reference populations: workers and non-workers within the cohort, the general Dutch population (controlled for age, sex and education level), the American OAI cohort, and, regarding work capacity, healthy working subjects. These comparisons contribute to the ‘known groups’ validity of these work measures.

Scientific evidence was found to substantiate some ‘evident empirical opinions’. Working subjects who had been on sick-leave reported a significantly worse health status than those who did not report sick-leave. Female subjects who reported a better physical function also reported to be more physically active (in work and leisure time), performed better on the FCE and a higher proportion of them had paid work, compared to groups with worse physical function. The CHECK study was not designed to establish causal relations in these matters, but indications for bi-directional relations between these variables were found. For clinical and occupational practice this means that it is important to stimulate people to be active, get active and stay active, because this offers the best conditions for a good physical functioning.

Also new was the recognition that for the target population of relatively young subjects with early OA, specific performance-based testing was needed. Usually low-intensity activities such as getting up from a chair and walking short distances were applied in OA patients. Follow-up studies with FCE in CHECK will generate the first longitudinal study on work related functional capacity.

RECOMMENDATIONS

Health care professionals:

Patients with (early) OA of the hips or the knees may need to consult several health care professionals: the general practitioner, the occupational physician, the rheumatologist, the orthopaedic surgeon, and the physical therapist. The occupational physician is obviously the medical professional with the most direct contact to the work situation. Our study demonstrated that CHECK subjects rarely saw this physician. Even in the group that reported sick-leave only 31% visited him/her. The reasons for this are unclear. All Dutch employees should be enabled to have access to an occupational physician. The general practitioner has probably the best awareness of the patient's general health state, whereas a rheumatologist and an orthopaedic surgeon are the clinical specialists who see only a selection of patients with severe symptoms and being at risk of leaving the work force. In subjects in the working age, all physicians and other health care providers should discuss the relation between the complaints and the patient's work. This issue should more frequently be a topic in professional journals, congresses and education.

Physical therapists often have the most frequent and longest contact with patients. They may help to alleviate OA symptoms and also give patients information. Through physical training and behaviour and lifestyle coaching, physical therapists can stimulate active participation in daily life, including work. There are networks of physical therapists with advanced education on occupational health who supply their services, via health insurance, to companies. The professional association, KNGF/NVBF, opened a register to assure the professional quality of these specialized therapists and to present them to interested customers. These developments should be continued and extended further to collaboration with other health professionals, the development of guidelines, and wide spread education.

Universities of Applied Sciences, as for example Saxion in Enschede and Deventer, are challenged to play an innovative and leading role here. Their newly developed Expertise Centres and Professorships are conducting research and education programmes, in collaboration with the regional field of practitioners. In the area of occupational health, Saxion is planning to develop an educational course for physical therapists, at Professional Master level. The curriculum will include preventive, diagnostic and therapeutic modalities, besides training in advising and consulting competences. In Bachelor programmes, Saxion offers a Minor course 'Work and Health', optional for students of different Major disciplines as for example Physical Therapy, Human Resources Management and Nursing. The case manager's role with regards to work, sick leave and return-to-work is ideally taken by an official in a (larger) company, or by an independent advisor who works for several smaller companies. The Minor aims to prepare the most talented amongst the students for this role.

Regarding the objective of remaining work capacity and keeping a paid job, all these professionals need to advise and support patients in a consistent way. Communication and collaboration are obvious ways of achieving this, but this is a stubborn issue and seamless care is not common practice yet. Professional guidelines, including the 3B-guidelines of the Health Council (28) and training programmes that aim to stimulate collaboration between general practitioners and occupational physicians have been developed. Unfortunately, results of these efforts do not last, mainly because of psychological factors as trust, attitude and behaviour (29). However, education programmes for doctors and therapists, available communication technology and customer demands all change rapidly. Stakeholders must continue to put effort into the aim of remaining people's work ability, because the societal relevance of this issue will only increase.

Besides the effect of OA on peoples work, also the causative side of the issue needs attention. The awareness that not only back complaints and complaints of arms, neck and shoulders (CANS) can be caused by work, but hip and knee complaints too, needs to be stimulated. In the Netherlands the incidence of knee and hip OA, officially registered as an occupational disease in 2008 was 121

and 42, respectively, which is a clear increase compared to 2007. The Netherlands Center for Occupational Diseases explained this increase by pointing out the publication of new registration guidelines for these disorders and the attention for these guidelines in the professional guidelines and in education.

Patient associations and platforms

Associations of patients and professionals have taken several initiatives to raise attention for the issue of work for people with chronic disease. The Dutch Arthritis Association yearly grants the Support Award to stimulate attention for and communication about chronic disease and work. The Award is granted to people who support a colleague with arthritis to stay at work. World Arthritis Day is a global awareness raising day, every year on the 12th of October. The theme for 2009 was "Let's Work Together" and considered the challenges of work for people with rheumatic diseases, healthcare professionals and employers. At a Symposium during the 2009 EULAR congress, entitled 'Fighting Musculoskeletal Diseases to keep the European population Fit for Work', researchers, doctors and patient groups appealed on rheumatologists and related healthcare professionals to view their patients as productive workers. Keeping them in a job should be an important goal and outcome in managing their condition. Campaigns and programmes such as these are continuously needed to change attitudes and behaviour of everyone involved in the care for people with chronic diseases as for example OA.

Politics and social partners:

Politicians who are setting the direction towards a higher work participation must realise that the public health situation may determine the limitations of this objective. The prevalence of several health disorders, among which osteoarthritis, increases. By stretching the 'borders', the limits of peoples' capacities will be tested and possibly passed. Therefore resources have to be created and stimulated:

Monitoring the impact of patients' health conditions on work participation and work capacity; the Work Ability Index may be considered as one of the instruments in practice and also scientific evidence is continuously gathered.

Because of the changes in the Dutch law on working conditions ("Arbeidsomstandighedenwet") employers are reconsidering on ways to organize the issue of work and health. Health management offers opportunities, providing that attention for the work situation is integrated. For these purposes competent consultancy should be hired if necessary.

Themes as vitality, work passion and inspiration and age adapted policy are 'hot' in Human Resources Management. If these tools are effective in improving workers' satisfaction, they can help achieving the objective of higher work participation. Research should prove whether the concepts are 'sustainable' or just hypes.

Given the higher prevalence and incidence of OA in women aged 55-65, the strive for increased work participation of women needs attention. For both male and female workers the ergonomic adagium is 'fitting the job to the man'.

Research:

In the CHECK cohort the issue of work participation has to be followed during the whole study. This will give insight into the course of work consequences during progress of the disorder, possibly including the issue of return-to-work after total hip or knee arthroplasty. More adequately designed longitudinal studies on the course of work participation in people with OA should be performed, with attention for processes in the work situation, in order to identify supportive and obstructive factors.

Research on better instruments to evaluate the impact of health disorders on work participation should be continued.

The use of FCE as a work-specific form of performance testing should be further developed and studied. Physical therapists can add FCE to their toolbox in order to objectify their insight into matters of work load and worker capacity.

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SUMMARY

Osteoarthritis (OA) is a degenerative disorder of the joints, that affects many people in their activities of daily life. OA has for a longtime been considered to be an inevitable, commonplace consequence of ageing, with few treatment options. However, recently this view on the nature of the disorder has changed and it has also become clear that many people with OA are younger than 65 years and still working. Their physical functioning and their participation in paid work may be affected by the disorder. Good studies on this topic appear to be scarce, although many authors suggest that the costs of productivity loss, sick leave and work disability caused by OA are high. The Cohort Hip and Cohort Knee (CHECK study), with 1002 participants aged 45 to 65 at baseline, formed a good infrastructure to study the impact of the early stage of the disorder on work participation.

In the introductory Chapter the incidence and prevalence of OA in the Netherlands are described. The ICF model is introduced as framework to analyze the consequences of OA for people's health and functioning, specifically with regards to paid work. The Cohort Hip and Cohort Knee (CHECK study) is described, from which the baseline and 2-years follow-up data were used in the seven studies presented in this thesis. The main study objectives are postulated, to be answered by two studies on the work participation of all 1002 cohort participants and four studies on the work capacity of 93 CHECK participants, all preceded by a systematic literature review.

In Chapter 2 a systematic review of existing literature on the impact of osteoarthritis on work participation is described. A systematic search for studies involving patients with hip or knee OA and outcome measures on work participation was performed. Methodological quality and main results of the 14 articles that were included in the final selection were described. It was concluded that there were large variations between the studies, in design, population, definitions and measurement instruments. In many studies work outcomes were only secondary objectives and may have been prone to confounding by over representation of older subjects. With some reservation the outcomes can be summarized as showing a mild negative effect of OA on work participation. Many patients managed to have paid work, despite work limitations. The level of sick leave and early retirement was not very high or not different from controls. The longitudinal course of work participation in individuals with OA has not been described completely, more longitudinal research is needed.

In Chapter 3 the work participation of people with early OA was determined at the baseline measurement of the CHECK study. The 1002 subjects were compared, matched for age, sex and education level, to the general Dutch population and to the American Osteoarthritis Initiative (OAI) cohort study. In both cohorts the self-reported health and functional status (SF-36 and WOMAC) of subjects with a paid job were compared to those of subjects without paid jobs. Furthermore, the prevalence of sick-leave and work adaptations was determined. Of the CHECK subjects (mean age 56 years, 79% female) 51% had a paid job for 8 hours or more per week. This was similar to the general Dutch population, matched for sex, age and education level, but much lower than in the American cohort, where the participation rate was 77%. Work adaptations were reported by 14% of the subjects and desired by another 16%; working fewer hours was the most frequently reported adaptation. 12% Had been on sick-leave because of their hip or knee symptoms in the past 12 months. In both cohorts the working subjects reported a slightly better health and physical functioning than the non working subjects; these differences remained after correcting for sex, age and education level in CHECK. This study demonstrates that health status was related to work status. The international comparison shows that societal factors also have an impact on work participation in the early stage of OA. The voluntary choice of not having paid work may be easier to afford financially for subjects in the Netherlands than for Americans.

In Chapter 4 the course of work participation from baseline to 2-years follow-up measurement was described. Questionnaire data from 925 subjects were analyzed. The participation in paid work decreased from 51% at baseline to 46% at follow-up, which is again similar to the general Dutch population. Health and functional status and personal factors of 61 subjects who stopped working were compared to the 414 who continued working. The subjects who stopped were on average 4.2 years older and more often reported

previous sick-leave at the baseline measurement. This sick-leave was mainly caused by other health complaints than the hip or knee symptoms. This study indicated that early OA does not have an additional effect on the decrease in work participation that is observed in the general population. Many patients seem to be able to cope with their symptoms. To find out more specific reasons for either continuing or giving up work, qualitative studies are recommended. These should address factors such as patients' coping style, psychosocial work circumstances and the involvement of employers and occupational physicians in decisions on work.

In Chapter 5 the reproducibility of Functional Capacity Evaluation (FCE) in subjects with OA was examined. FCE was never used before on subjects with OA and therefore the clinimetrical quality was unknown. For this reason the necessity of the standard routine of 2-day testing was examined. In the Work Well FCE the test items lifting low, lifting overhead and carrying, were performed on both of the 2 consecutive test days. Seventy-nine subjects participated in this study, their mean (SD) age was 56.6 (4.8) years, median (min–max) WOMAC scores for pain, stiffness and physical function were 5 (0–17), 3 (0–7) and 14 (0–49), respectively. Median (min–max) SF-36 physical function was 75 (5–95), and SF-36 pain score was 67 (12–76). Mean performance differences ranged from −0.2 to −0.8 kg ($P > 0.05$). ICC's ranged from 0.75 (lifting overhead) to 0.88 (lifting low). Limits of Agreement (LoA) were: lifting low 8.0 kg; lifting overhead 6.5 kg; carrying 9.0 kg. All three tests showed acceptable two-day consistency. FCE testing on two consecutive days is not necessary for groups of subjects with early osteoarthritis. Individual sources of variation could not be identified.

In Chapter 6 the self-reported functional status (in SF-36 and WOMAC questionnaires) was compared to the observed performance in an FCE test. Ninety-two subjects scored physical function on SF-36 (scale 0–100, 100 indicating the best health level) and WOMAC (scale 0–68, 68 indicates maximum restriction) and performed the FCE. Cross-tables were constructed, to assess the potential use of both questionnaires as diagnostic tests to identify work limitations. Subjects lifting <22.5 kg on the FCE-test 'lifting-low' were labeled as having physical work limitations. The results of a diagnostic cross-table with cut-off point <60 on SF-36 'physical functioning' were: sensitivity 0.34, specificity 0.97 and positive predictive value (PPV) 0.95. A cut-off point of ≥21 on WOMAC 'function' resulted in sensitivity 0.51, specificity 0.88 and PPV 0.88. In conclusion, low self-reported function scores on SF-36 and WOMAC could be used to diagnose subjects with limitations on the FCE. However, high scores did not guarantee an observed performance without physical work limitations. To assess the actual work capacity of subjects with OA, FCE may be indicated to help clinicians.

In Chapter 7 the self-reported health status and functional capacity of subjects with early OA of hip and/or knee were compared to reference data of healthy working subjects. The ShortForm-36 Health Survey (SF-36) and 6 tests of the Work Well FCE were used and results were compared with reference data from 275 healthy workers. To compare the functional capacity with job demands, the proportions of subjects with OA performing lower than the p5 of reference data were calculated. Compared to healthy workers, all subjects from CHECK (mean age 56) at baseline reported a significantly worse physical health status, whereas the females (n=78) also reported a worse mental health status. On the FCE female OA subjects performed significantly lower than their healthy working counterparts on all 6 tests. Male OA subjects performed lower than male workers on 3 tests. A substantial proportion of females demonstrated functional capacities that could be considered insufficient to perform jobs with low physical demands. This study indicates that the self-reported health status and the functional capacity of subjects with early OA are lower compared to healthy working subjects.

To get more insight in movement behaviour and physical functioning of women with osteoarthritis (n=78), in Chapter 8 the association between self-reported function and functional capacity, work status and physical activities in daily life was examined. The WOMAC was used to measure physical functioning; based on the scores the women were divided into 3 groups of 26 (group 1-least limitations, group 3-most limitations). Functional capacity was assessed with the Work Well FCE. Work participation and physical activities were measured with a questionnaire. WOMAC-scores appeared to have a wide range in the 3 groups (mean scores 6, 17 and 34 respectively). Correlations between WOMAC score and FCE

scores varied from -0.32 to -0.46. Differences in FCE-scores were found, group 1 scored better than group 2 on most tests and group 2 scored better than group 3. The proportion of women with paid work in the groups 1, 2 and 3 was 70%, 57% and 26% respectively. Lastly, groups with better WOMAC scores reported higher levels of activities in leisure time. Group 3 demonstrated by far the most limitations. In conclusion, the WOMAC-score for physical functioning at group level showed relations with all 3 outcome measures: better physical function corresponds with higher functional capacity, higher work participation and more physical activity. Physical therapists who use the WOMAC can estimate the movement behaviour of women with early osteoarthritis. Furthermore, they should stimulate patients with OA to stay physically active as much as possible.

In the final Chapter, Chapter 9, the main findings of the thesis are presented, the results and some methodological issues are discussed, and implications and recommendations for health care, society and for future research are given. The current body of knowledge regarding the impact of OA on work participation was shown to be inconclusive. Very few studies were designed adequately to generate valid conclusions on this impact. Some of the more recent studies focused specifically on working OA subjects and the work transitions that they made. Our studies also had this focus and furthermore enabled comparisons between working subjects and non working subjects.

A main objective of this thesis was to document work participation and it's 2-years course in subjects with early OA. Both were similar to the general Dutch population, stratified for sex, age and education level. A higher age and having been at sick-leave at baseline were the only factors associated with leaving the work force in the first two years of the CHECK study. Sick-leave rate was not very high at both measurements, about 11% of subjects reported having been on sick-leave in the past year. There was an increase in the proportion of subjects who reported having made work adaptations because of their symptoms, from 14% at baseline to 20% at 2-years follow-up; more subjects would like their work to be adapted. However, only few subjects visited an occupational physician. It was concluded that in the early phase of OA there was

no impact on work participation. Even so, there were some signs which could be starting points for preventive interventions.

Another main objective of this thesis was to evaluate the functional capacity of subjects in the cohort with an FCE. Poor self-reported function was shown to predict low functional capacity and subjects with OA had lower functional capacities than healthy working controls. A substantial proportion of females demonstrated functional capacities that could be considered insufficient to perform jobs with low physical demands.

In conclusion, the impact of early OA of the hip or the knee on work participation in the first 2 years seems to be mild, partly because it is concealed by the Dutch 'tradition' of early retirement. The work adaptations that were realized and are still desired by the CHECK subjects and their low functional capacities may indicate that some of the subjects are at risk for work disability and for prematurely leaving the work force. Monitoring this impact is therefore advised and work should be a topic in every contact between patient and health care professional. Momentary and future efforts to increase the work participation, specifically in older female workers, should take the effects of OA into account. Preventive interventions have to be developed collaboratively by representatives of working patients, employers and health care professionals, to enable longer work participation.

SAMENVATTING

Artrose is een degeneratieve aandoening van het kraakbeen, waarbij ook de andere structuren in de gewrichten betrokken zijn. Lange tijd is artrose beschouwd als een normaal en onvermijdelijk gevolg van het ouder worden, met weinig behandelmogelijkheden. Geleidelijk is deze visie op de aard van de aandoening echter veranderd en is ook duidelijk geworden dat veel mensen met artrose jonger zijn dan 65 jaar en nog betaald werk verrichten. Hun fysieke functioneren en hun arbeidsparticipatie kunnen gehinderd worden door de aandoening. Goed onderzoek naar dit onderwerp blijkt schaars te zijn, hoewel veel auteurs suggereren dat artrose hoge kosten veroorzaakt vanwege productiviteitsverlies, ziekteverzuim en arbeidsongeschiktheid. Het Cohort Heup En Cohort Knie (CHECK), een 10-jarig onderzoek met 1002 deelnemers in een leeftijd tussen 45 en 65 jaar bij aanvang van het onderzoek, leverde een prachtig databestand om de invloed van de vroege fase van artrose op arbeidsparticipatie te onderzoeken.

In het inleidende hoofdstuk worden de incidentie en prevalentie van artrose in Nederland beschreven. Het ICF model (International Classification of Functioning, Disability and Health) wordt geïntroduceerd als kader waarbinnen de gevolgen van artrose voor de gezondheid en het functioneren van mensen geanalyseerd worden, met specifieke aandacht voor betaald werk. CHECK wordt beschreven, waarvan de baseline en 2-jaars follow-up data gebruikt zijn in de 7 studies die in dit proefschrift gepresenteerd worden. De belangrijkste onderzoeksdoelen worden geformuleerd; deze zullen beantwoord worden in 2 studies naar de arbeidsparticipatie van alle 1002 cohort deelnemers en 4 studies naar de arbeidscapaciteit van 93 deelnemers, voorafgegaan door een systematische literatuur review.

In Hoofdstuk 2 wordt een systematische review van de literatuur over de invloed van artrose op arbeidsparticipatie beschreven. Er is een systematische zoekactie uitgevoerd naar studies bij mensen met heup- of knieartrose, waarin uitkomstmaten betreffende arbeidsparticipatie gepresenteerd zijn. Beschreven worden de methodologische kwaliteit en de belangrijkste bevindingen van de 14 uiteindelijk geïncludeerde artikelen. Er is geconcludeerd dat er grote variatie bestaat tussen de studies, qua design, populatie, definities en meetinstrumenten. Veelal betroffen de aan werk gerelateerde uitkomstmaten slechts secundaire onderzoeksdoelen. Met enig voorbehoud kunnen de uitkomsten samengevat worden als een mild negatief effect van artrose op arbeidsparticipatie. Veel mensen met artrose slagen erin betaald werk uit te voeren, ondanks beperkingen. Het niveau van ziekteverzuim en vervroegde uittreding was niet hoog of niet verschillend van controlegroepen. Het beloop van arbeidsparticipatie van mensen met artrose is nog niet compleet in beeld gebracht, met als constatering dat er meer longitudinaal onderzoek nodig is.

In Hoofdstuk 3 wordt de arbeidsparticipatie van mensen met beginnende artrose beschreven bij de baseline meting van CHECK. De 1002 deelnemers werden (gematched voor leeftijd, geslacht en opleidingsniveau) vergeleken met de algemene Nederlandse bevolking en met de Amerikaanse Osteoarthritis Initiative (OAI) cohort studie. In beide cohorten zijn de zelfgerapporteerde gezondheid en de functionele status (gemeten met SF-36 en WOMAC) vergeleken, van deelnemers met betaald werk en die zonder betaald werk. Verder werd de frequentie van ziekteverzuim en van werkaanpassingen gemeten. Van de CHECK deelnemers (gemiddelde leeftijd 56 jaar, 79% vrouwen) had 51% betaald werk voor 8 uur of meer per week. Dit kwam overeen met de Nederlandse bevolking, maar was lager dan in de OAI, waar de participatie 77% was. Werkaanpassingen werden gerapporteerd door 14% van de deelnemers en gewenst door nog eens 16%; minder uren werken was de meest genoemde aanpassing. Werkverzuim in de afgelopen 12 maanden vanwege heup- en knieklachten werd gemeld door 12%. Zowel in CHECK als in OAI rapporteerden de werkenden een iets betere gezondheid en een beter fysiek functioneren dan de niet-werkenden; deze verschillen bleven bestaan na correctie voor leeftijd, geslacht en opleidingsniveau. Deze studie toont aan dat de gezondheidstoestand gerelateerd is aan de werkstatus. De internationale vergelijking laat zien dat maatschappelijke factoren ook invloed hebben op de arbeidsparticipatie bij vroege artrose. Mogelijk kunnen Nederlanders zich de vrije keuze om niet te werken financieel gemakkelijker veroorloven dan Amerikanen.

In Hoofdstuk 4 wordt het beloop van de arbeidsparticipatie vanaf baseline tot de 2-jaars follow-up meting beschreven. Er werden vragenlijstdata van 925 deelnemers geanalyseerd. De participatie in betaald werk daalde van 51% tot 46%, wat opnieuw overeenkwam met cijfers van de Nederlandse bevolking. De gezondheid, de functionele status en de persoonlijke factoren van de 61 deelnemers die stopten met werken, werden vergeleken met die van de 414 deelnemers die bleven werken. De personen die stopten met werken waren gemiddeld 4.2 jaar ouder en rapporteerden vaker een voorafgaand ziekteverzuim. Dit verzuim was overwegend vanwege andere gezondheidsklachten dan de heup- en knieklachten. Van de deelnemers rapporteerde 20% werkaanpassingen te hebben gedaan (tegen 14% bij baseline). Deze studie toont aan dat beginnende artrose in 2 jaar tijd geen additioneel effect heeft, boven de afname in arbeidsparticipatie die met de leeftijdstoename optreedt in de algemene bevolking. Veel personen lijken in staat te zijn om goed met hun symptomen om te gaan. Om meer specifieke redenen te kunnen vaststellen voor het al dan niet doorgaan met werk, wordt kwalitatief onderzoek aanbevolen. Daarin moeten factoren onderzocht worden als coping stijl, psychosociale werkomstandigheden en de betrokkenheid van werkgevers en bedrijfsartsen in beslissingen over werk.

In Hoofdstuk 5 is de reproduceerbaarheid van Functionele Capaciteits Evaluatie (FCE) bij mensen met beginnende artrose onderzocht. Omdat FCE nooit eerder bij personen met deze aandoening werd onderzocht, was de klinimetrische kwaliteit ervan onbekend. Daarom werd in deze studie de noodzaak onderzocht om, conform de destijds geldende standaardprocedure, 2 dagen te testen. In de Work Well FCE worden de testonderdelen tillen laag, tillen hoog en dragen kort uitgevoerd op 2 opeenvolgende dagen. Negenenzeventig personen, met een gemiddelde leeftijd van 56.6 (4.8) jaar, namen deel aan dit onderzoek. De mediane scores (min-max) op de WOMAC-schalen pijn, stijfheid en functie waren respectievelijk 5 (0-17), 3 (0-7) en 14 (0-49). De mediane scores (min-max) op de SF-36 waren voor de schaal fysiek functioneren 75 (5-95) en voor de schaal pijn 67 (12-76). De gemiddelde testverschillen op de FCE tussen dag 1 en dag 2 varieerden van -0.2 tot -0.8 kg (P>0.05). ICC's varieerden van 0.75 (tillen hoog) tot 0.88 (tillen laag). De Limits of Agreement (LoA) waren: tillen laag 8.0 kg; tillen hoog 6.5 kg; dragen kort 9.0 kg.

Alle 3 tests lieten daarmee acceptabele consistentie over 2 dagen zien. Het afnemen van de FCE op 2 opeenvolgende dagen is niet nodig voor groepen mensen met beginnende artrose. Bronnen van variatie tussen individuen konden niet aangetoond worden.

In Hoofdstuk 6 is de zelfgerapporteerde functionele status (met SF-36 en WOMAC vragenlijsten) vergeleken met de geobserveerde prestaties op de FCE. Tweeënnegentig personen scoorden hun fysieke functioneren op de SF-36 (schaal 0-100, met 100 als de beste gezondheidstoestand) en op de WOMAC (schaal 0-68, met 68 als maximale beperkingen) en namen deel aan de FCE. Er werden kruistabellen opgesteld om het mogelijke gebruik van beide vragenlijsten als diagnostische tests voor het opsporen van arbeidsbeperkingen te onderzoeken. Personen die <22.5 kg tilden op de FCE-test tillen laag werden daarbij beschouwd als degenen met arbeidsbeperkingen. De resultaten van een diagnostische kruistabel met afkapwaarde <60 op de SF-36-schaal fysiek functioneren waren: sensitiviteit 0.34; specificiteit 0.97 en voorspellende waarde van een positieve test 0.95. Een afkapwaarde van ≥21 op WOMAC functie resulteerde in: sensitiviteit 0.51; specificiteit 0.88 en een voorspellende waarde van een positieve test van 0.88. Concluderend kan een laag niveau van zelfgerapporteerd fysiek functioneren op de SF-36 en de WOMAC worden gebruikt om personen met arbeidsbeperkingen op de FCE te diagnosticeren. Hoge scores garanderen echter geen geobserveerde prestatie zonder arbeidsbeperkingen. Om clinici te helpen de werkelijke arbeidscapaciteit van personen met artrose vast te stellen, wordt aanbevolen een FCE af te nemen.

In Hoofdstuk 7 zijn de zelfgerapporteerde gezondheidstoestand en de functionele capaciteit van personen met beginnende artrose van heup en/of knie vergeleken met referentie data van gezonde werkende personen. De SF-36 en 6 tests van de Work Well FCE zijn gebruikt en de resultaten hiervan zijn vergeleken met referentie data van 275 gezonde werkers in dezelfde leeftijdscategorie. Om de functionele capaciteit te vergelijken met fysieke functie-eisen, zijn de proporties van personen met artrose die lager presteerden dan de p5-waarden van de referentiegroep berekend. Vergeleken met de gezonde werkers, rapporteerden alle personen uit CHECK (gemiddelde leeftijd 56 jaar) bij de baseline meting een significant slechtere fysieke gezondheidstoestand, terwijl de vrouwen (n=78)

ook een slechtere mentale gezondheidstoestand aangaven. Op de FCE presteerden de vrouwen met artrose op alle 6 tests significant minder dan de gezonde werkende vrouwen. De mannen met beginnende artrose presteerden minder dan de gezonde werkende mannen op 3 tests. Een aanzienlijk deel van de vrouwen had een functionele capaciteit die als onvoldoende beschouwd kan worden om werk met lage fysieke functie-eisen uit te voeren. Dit onderzoek toont aan dat de zelfgerapporteerde gezondheid en de functionele capaciteit van personen met beginnende artrose slechter zijn dan die van gezonde werkende personen.

Om meer inzicht te krijgen in het fysieke functioneren en het beweeggedrag van vrouwen met beginnende artrose (n=78), is in Hoofdstuk 8 de associatie onderzocht tussen het zelfgerapporteerde fysieke functioneren en de functionele capaciteit, de arbeidsstatus en de fysieke activiteit in de vrije tijd. De WOMAC is gebruikt om fysiek functioneren te meten; op basis van de scores zijn de vrouwen in 3 groepen van 26 verdeeld (groep 1 – minste beperkingen, groep 3 – meeste beperkingen). Functionele capaciteit is gemeten met de WorkWell FCE. Arbeidsparticipatie en fysieke activiteit zijn gemeten met een vragenlijst. De WOMAC-scores bleken een grote spreiding te hebben (groepsgemiddelden van 6, 17 en 34). De correlaties tussen WOMAC score en FCE score varieerden van -0,32 tot -0,46. Er zijn verschillen in FCE-resultaten gevonden, groep 1 scoorde op de meeste tests beter dan groep 2, en groep 2 scoorde beter dan groep 3. De proportie vrouwen met betaald werk in de groepen 1, 2 en 3 was respectievelijk 70%, 57% en 26%. Groepen met betere WOMAC-scores rapporteerden hogere niveaus van lichamelijke activiteit in de vrije tijd. Groep 3 liet met afstand de meeste beperkingen zien. Concluderend liet de WOMAC-score voor fysiek functioneren op groepsniveau een relatie zien met alle 3 de uitkomstmaten: beter fysiek functioneren correspondeert met hogere functionele capaciteit, hogere arbeidsparticipatie en meer fysieke activiteit. Fysiotherapeuten kunnen met de WOMAC het beweeggedrag van vrouwen met beginnende artrose schatten. Verder dienen zij patiënten met artrose te stimuleren om zoveel als mogelijk fysiek actief te blijven.

In het laatste hoofdstuk, Hoofdstuk 9, worden eerst de belangrijkste uitkomsten van het proefschrift gepresenteerd, waarna de resultaten en een aantal methodologische thema's bediscussieerd worden. Afgesloten wordt met de implicaties en aanbevelingen voor de gezondheidszorg, de maatschappij en voor toekomstig onderzoek. Het proefschrift toont aan dat de huidige kennis betreffende de effecten van artrose op arbeidsparticipatie onvolledig is. In de literatuur zijn slechts enkele studies gevonden met een adequate opzet, die geldige conclusies over dit effect opleverden. Enkele meer recente studies richtten zich specifiek op werkende personen met artrose en op de werkaanpassingen die zij maakten. Ons eigen onderzoek had ook specifieke aandacht voor dit thema en maakte bovendien vergelijkingen tussen werkende en niet-werkende personen.

Een belangrijk doel van dit proefschrift was het vastleggen van de arbeidsparticipatie en het 2-jarige beloop daarvan, van personen met beginnende artrose van de heup en/of knie. Hierin blijkt geen verschil te zijn met de algemene Nederlandse bevolking, gestratificeerd voor geslacht, leeftijd en opleidingsniveau. Het ziekteverzuim tijdens beide metingen was niet hoog, ongeveer 11% van de deelnemers gaf aan te hebben verzuimd in het voorafgaande jaar. Er was een toename te zien in het percentage personen dat hun werk aanpaste vanwege hun klachten, van 14% bij baseline tot 20% bij de 2-jaars meting; een groter deel van de personen maakte de wens kenbaar om hun werk aan te passen. Echter, slechts enkele personen bezochten een bedrijfsarts. De conclusie luidt dat er in de vroege fase van artrose geen effect op arbeidsparticipatie is. Toch zijn er enkele aanwijzingen, die aanknopingspunten bieden om preventieve interventies te starten zodra dit nodig is.

Een ander hoofddoel van dit proefschrift was het beoordelen van de functionele capaciteit van de personen in het artrosecohort. Een slecht zelfgerapporteerd fysiek functioneren blijkt voorspellend voor een lage functionele capaciteit en CHECK-deelnemers hebben een lagere functionele capaciteit dan gezonde werkende personen. Een aanzienlijk deel van de vrouwen heeft een functionele capaciteit die als onvoldoende beschouwd kan worden om werk met lage fysieke functie-eisen uit te voeren.

Samengevat is er in de eerste 2 jaren een mild effect van vroege artrose van de heup en/of knie op arbeidsparticipatie, deels doordat dit effect verborgen wordt door de Nederlandse gewoonte om vervroegd met pensioen te gaan. De uitgevoerde en gewenste werkaanpassingen van de CHECK-deelnemers en hun lage functionele capaciteit vormen aanwijzingen, dat zij risico lopen om arbeidsongeschikt te worden en vroegtijdig te stoppen met werken. Het monitoren van deze factoren wordt daarom aanbevolen. Daarnaast zou in ieder contact tussen patiënt en zorgprofessionals werk een gespreksonderwerp moeten zijn. Huidige en toekomstige inspanningen om de arbeidsparticipatie te verhogen, specifiek die van oudere vrouwelijke werknemers, moeten rekening houden met het effect van artrose op de arbeidscapaciteit. Vertegenwoordigers van de patiëntengroep, werkgevers en professionals in de gezondheidszorg dienen samen te werken aan preventieve interventies om langere arbeidsdeelname in gezondheid mogelijk te maken.

CURRICULUM VITAE

André Bieleman werd op 21 maart 1964 geboren in Doetinchem. Daar ging hij ook naar de lagere en middelbare school, de muziekschool en de voetbalvereniging. Na het behalen van het VWO-diploma studeerde hij bewegingswetenschappen aan de Vrije Universiteit in Amsterdam. In november 1987 deed hij zijn doctoraal examen en behaalde hij de 1e-graads docentenbevoegdheid. De jaren daarna was hij dienstplichtig officier bij de Sectie Trainingsgeneeskunde en Trainingsfysiologie van de Koninklijke Landmacht. Daarvoor en daarna had hij enkele tijdelijke baantjes, o.a. als postbode, docent bij de Academie Fysiotherapie Thim van der Laan, assistent van een arbeidsdeskundige en secretarieel medewerker op het Academisch Ziekenhuis in Utrecht.

Sinds 1990 werkt hij bij Saxion in Enschede, met o.a. taken als docent in bachelor- en masteropleidingen, minorcoördinator, cursusleider, projectleider en onderzoeker. De centrale thema's in al die activiteiten zijn arbeid&gezondheid, fysiotherapie&preventie, en research. De laatste jaren werkt hij binnen het Kenniscentrum Gezondheid, Welzijn en Technologie van Saxion, in het Lectoraat Gezondheid en Bewegen. Sinds 2005 heeft hij onderzoek gedaan in het Cohort Heup En Cohort Knie (CHECK), in een projectgroep met collega's van de Rijksuniversiteit Groningen, UMCG en de Hanzehogeschool.

André is daarnaast secretaris van de Stichting Registratie Bedrijfs Fysiotherapeuten (SRBF).

Hij is getrouwd en heeft 3 kinderen. Na de promotie zal hij als programmaleider van de lijn Arbeid&Gezondheid actief blijven op het terrein van onderzoek en onderwijs.

DANKWOORD

Op maandag 8 maart lag er dan ‘opeens’, zo voelde het tenminste, een dik pak papier gereed voor verzending naar de leescommissie. Het werk van de afgelopen 4 jaren, teruggebracht tot 145 bladzijden met tekst en cijfers. Het gaf een voldaan gevoel om ruim 22 jaar na mijn doctoraal examen in de bewegingswetenschappen 7 artikelen geschreven te hebben, die gebundeld dit proefschrift vormen. Dat het daar nog eens van zou komen had ik tot een jaar of 6 geleden, toen het idee ontstond, nooit meer gedacht. Ik wil daarom allereerst mijn dank uitspreken aan de raad van bestuur van Saxion en de bestuurders van het Kenniscentrum Gezondheid, Welzijn en Technologie, die op voortvarende wijze mogelijk hebben gemaakt dat docenten bij Saxion onderzoek doen en daarop promoveren.

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Co-supervisors: dr JH van Loenhout-Rooyackers, dr AG Veldhuizen

Leertouwer H (2006) Het heil van de gezonden zij onze hoogste wet; de geschiedenis van de medische afdeling bij de arbeidsinspectie
Supervisors: prof dr JW Groothoff, prof dr MJ van Lieburg, prof dr D Post

Jansen DEMC (2006) Integrated care for intellectual disability and multilpe sclerosis
Supervisors: prof dr D Post, prof dr JW Groothoff
Co-supervisor: dr B Krol

Van Ham I (2006) De arbeidssatisfactie van de Nederlandse huisarts
Supervisors: prof dr J de Haan, prof dr JW Groothoff
Co-supervisor: dr KH Groenier

Jansen GJ (2005) The attitude of nurses towards inpatient aggression in psychiatric care: the development of an instrument
Supervisors: prof dr SA Reijneveld, prof dr ThWN Dassen
Co-supervisor: dr LJ Middel

Post M (2005) Return to work in the first year of sickness absence; an evaluation of the Gatekeeper Improvement Act
Supervisors: prof dr JW Groothoff, prof dr D Post
Co-supervisor: dr B Krol

Landsman-Dijkstra JJA (2005) Building an effective short healthpromotion intervention; theory driven development, implementation and evaluation of a body awareness program for chronic a-specific psychosomatic symptoms
Supervisor: prof dr JW Groothoff
Co-supervisor: dr R van Wijck

Bakker RH (2005) De samenwerking tussen huisarts en bedrijfsarts
Supervisor: prof dr JW Groothoff
Co-supervisors: dr B Krol, dr JWJ van der Gulden

Nagyová I (2005) Self-rated health and quality of life in Slovak rheumatoid arthritis patients
Supervisor: prof dr WJA van den Heuvel
Co-supervisor: dr JP van Dijk

Gerritsma-Bleeker CLE (2005) Long-term follow-up of the SKI knee prosthesis.
Supervisors: prof dr JR van Horn, prof dr RL Diercks
Co-supervisor: dr NJA Tulp

De Vries M (2005) Evaluatie Zuidoost-Drenthe HARTstikke goed!; mogelijkheden van community-based preventie van hart-en vaatziekten in Nederland
Supervisors: prof dr D Post, prof dr JW Groothoff
Co-supervisor: dr JP van Dijk

Jungbauer FHW (2004) Wet work in relation to occupational dermatitis
Supervisors: prof dr PJ Coenraads, prof dr JW Groothoff

Post J (2004) Grootschalige huisartsenzorg buiten kantooruren
Supervisor: prof dr J de Haan

Reneman MF (2004) Functional capacity evaluation in patients with chronic low back pain; reliability and validity
Supervisors: prof dr JW Groothoff, prof dr JHB Geertzen
Co-supervisor: dr PU Dijkstra

Bâra-Ionilă C-A (2003) The Romanian health care system in transition from the users' perspective
Supervisors: prof dr WJA van den Heuvel, prof dr JAM Maarse
Co-supervisor: dr JP van Dijk

De Lege W (2002) Medische consumptie in de huisartspraktijk op Urk
Supervisors: prof dr D Post, prof dr JW Groothoff

Hoekstra EJ (2002) Arbeidsbemiddeling met behulp van Supported Employment als interventie bij de reïntegratie van chronisch zieken; de rol van de arbeidsbemiddelaar, chronisch zieke en werkgever
Supervisors: prof dr JW Groothoff, prof dr K Sanders, prof dr WJA van den Heuvel, prof dr D Post

Enk JG van (2002) Determinants of use of healthcare services in childhood
Supervisors: prof dr D Post, prof dr AJP Veerman, prof dr WJA van den Heuvel

Gecková A (2002) Inequality in health among Slovak adolescents
Supervisors: prof dr D Post, prof dr JW Groothoff.
Co-supervisor: dr JP van Dijk

Van Dijk JP (2001) Gemeentelijk gezondheidsbeleid; omvang en doelgerichtheid
Supervisors: prof dr D Post, prof dr M Herweijer, prof dr JW Groothoff

Middel LJ (2001) Assessment of change in clinical evaluation
Supervisor: prof dr WJA van den Heuvel
Co-supervisor: dr MJL de Jongste

Bijsterveld HJ (2001) Het ouderenperspectief op thuiszorg; wensen en behoeften van ouderen ten aanzien van de thuis(zorg)situatie in Friesland
Supervisors: prof dr D Post, prof dr B Meyboom-de Jong
Co-supervisor: dr J Greidanus

Dijkstra GJ (2001) De indicatiestelling voor verzorgingshuizen en verpleeghuizen
Supervisors: prof dr D Post, prof dr JW Groothoff

Van Dalen IV (2001) Second opinions in orhopaedic surgery: extent, motives, and consequences
Supervisors: prof dr JR van Horn, prof dr PP Groenewegen, prof dr JW Groothoff

Beltman H (2001) Buigen of barsten? Hoofdstukken uit de geschiedenis van de zorg aan mensen met een verstandelijke handicap in Nederland 1945-2000
Supervisors: prof dr D Post, prof dr AThG van Gennep

Pal TM (2001) Humidifiers disease in synthetic fiber plants: an occupational health study
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Goossen WTF (2000) Towards strategic use of nursing information in the Netherlands
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Hospers JJ (1999) Allergy and airway hyperresponsiveness: risk factors for mortality
Supervisors: prof dr D Post, prof dr DS Postma, prof dr ST Weiss

Van der Wijk P (1999) Economics: Charon of Medicine?
Supervisors: prof dr WJA van den Heuvel, prof dr L Koopmans, prof dr FFH Rutten
Co-supervisor: dr J Bouma

Dijkstra A (1998) Care dependency: an assessment instrument for use in long-term care facilities
Supervisors: prof dr WJA van den Heuvel, prof dr ThWN Dassen

Tuinstra J (1998) Health in adolescence: an empirical study of social inequality in health, health risk behaviour and decision making styles
Supervisors: prof dr D Post, prof dr WJA van den Heuvel
Co-supervisor: dr JW Groothoff

Mink van der Molen AB (1997) Carpale letsels: onderzoek naar de verzuimaspecten ten gevolgen van carpale letsels in Nederland 1990-1993
Supervisors: prof dr PH Robinson, prof WH Eisma
Co-supervisors: dr JW Groothoff, dr GJP Visser

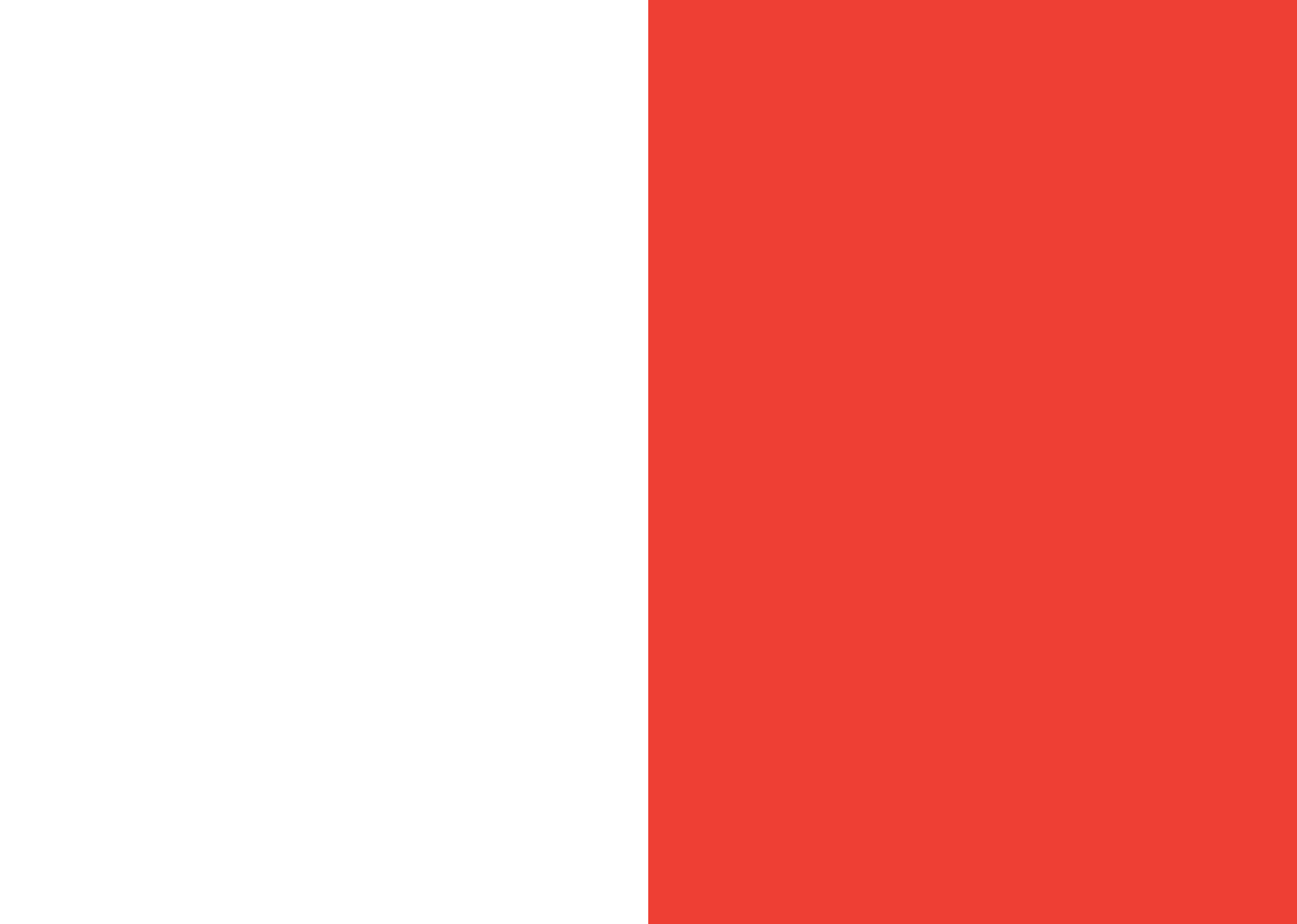
Mulder HC (1996) Het medisch kunnen: technieken, keuze en zeggenschap in de moderne geneeskunde
Supervisor: prof dr WJA van den Heuvel

Dekker GF (1995) Rugklachten-management-programma bij de Nederlandse Aardolie Maatschappij B.V.: ontwerp, uitvoering en evaluatie
Supervisors: prof dr D Post, prof WH Eisma
Co-supervisor: dr JW Groothoff

Puttiger PHJ (1994) De medische keuring bij gebruik van persluchtmaskers
Supervisors: prof dr D Post, prof dr WJA Goedhard
Co-supervisor: dr JW Groothoff

Engelsman C & Geertsma A (1994) De kwaliteit van verwijzingen
Supervisors: prof dr WJA van den Heuvel, prof dr FM Haaijer-Ruskamp, prof dr B Meyboom-de Jong

Van der Lucht F (1992) Sociale ongelijkheid en gezondheid bij kinderen
Supervisor: prof dr WJA van den Heuvel
Co-supervisor: dr JW Groothoff

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